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TECHNICAL MEMORANDUM

SYSTEM ASSESSMENT NO. 8

MEDICAL UNIT, SELF-CONTAINED, TRANSPORTABLE NON-MEDICAL COMPONENTS (MUST - NMC) A SYSTEM ASSESSMENT

BY

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(6)

MEDICAL UNIT, SELF-CONTAINED, TRANSPORTABLE NON-MEDICAL COMPONENTS (MUST - NMC).

(9) SYSTEM ASSESSMENT no. 8

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CONTENTS

EXECUTIVE SUMMARY

SYSTEM ASSESSMENT OF MEDICAL UNIT,
SELF-CONTAINED, TRANSPORTABLE,
NON-MEDICAL COMPONENTS (MUST - NMC)

SECTION I

1. INTRODUCTION

a. PURPOSE. The objective of this study is to present a disciplined review of the Medical Unit, Self-Contained, Transportable (MUST), Non-Medical Components (NMC). The study goal is to measure the effectiveness of the equipment to meet the requirements of its mission, and to determine what actions, if any, are indicated to make the system more effective. It is expected that this evaluation of the performance of fielded MUST equipment will lead to more efficient field performance. A briefing presented to the TROSCOM Commander on 4 May 1976 is attached (Appendix A).

b. BACKGROUND.

(1) The principal fielded non-medical components of the MUST are:

(a) Utility power unit

(b) Expandable shelter

(c) Multipurpose shelter

(d) Inflatable shelter.

All of the above are managed by TROSCOM.

(2) In 1963 the Garrett Corporation at the direction of the Surgeon General developed the basic features of the MUST complex. These features

include high mobility, reduced deployment time, high reliability, controlled environment, and all-weather operating capability.
Combining the above listed components, the MUST system utilizes the building block concept to provide efficient patient care with rapid deployment under combat constraints.

(3) A prototype hospital was developed in 1965, and operational testing performed in Southeast Asia (SEA) in 1966-67. Engineering and service tests, conducted in 1969, verified the design as acceptable.

(4) In development are:

(a) the Water and Waste Management Complex, and

(b) the Food Service Complex.

The Water and Waste Management Complex is currently undergoing Operational Test II (DT II). Because the prototype Food Service Complex was too heavy, too complex, and too costly, the Office of the Surgeon General (OTSG) terminated development responsibility and requested DARCOM to accept that function.

c. ASSUMPTIONS.

(1) At the time of this assessment, eighteen (18) active Army hospitals were MUST equipped. User questionnaires were sent to each of these units. Fourteen (14) of them responded. It is assumed that these responses are representative of all MUST equipped units.

(2) Likewise, assessment team members interviewed MUST hospital personnel at four U.S. Army posts, all within CONUS. It is assumed that these interviews pointed up problems that are common to all MUST Hospitals regardless of their locations.

d. FACTS BEARING ON THE PROBLEM.

(1) MUST hospital equipment has been issued to eighteen (18) Combat Support Hospitals and Evacuation Hospitals in CONUS and Europe. All of these hospitals are active Army units. Fourteen (14) are located in CONUS, and four are in Europe. Some of the hospitals are almost completely MUST equipped; others have token equipment.

(2) To acquire user information, a questionnaire was developed at TROSCOM and mailed to each of the MUST equipped hospitals. Questionnaires were mailed directly to the units located in Europe. The questionnaires for CONUS units were channeled through FORSCOM, which made further distribution to the hospitals. The same channels, in reverse, were followed in returning the completed questionnaires. The Surgeon General provided the TROSCOM authority to send the questionnaires to the using units.

e. METHODOLOGY. This assessment employed the following techniques:

(1) Analysis of TROSCOM developed questionnaires mailed to field users in Europe and CONUS.

(2) Interviews with users and maintenance activities at Ft. Bragg, Ft. Riley, Ft. Campbell, and Ft. Leonard Wood.

(3) Analysis of comments by developers (MERADCOM and NARADCOM) to questionnaires completed by field users.

(4) Analysis of comments provided by Tooele and Tobyhanna Army Depots.

(5) Examination of relevant MUST data in files of TROSCOM Special Items Management Office, Safety Office, and Directorates of Product Assurance, Materiel Management, Maintenance, and International Logistics.

(6) Referral of copies of completed questionnaires to TACOM for comments to remarks concerning TACOM managed Dolly Sets (Appendix B).

SECTION II

2. DISCUSSION.

a. METHODOLOGY AND DATA COLLECTION.

(1) User data are essential to this assessment. To acquire user data it was first necessary to determine the location (and mailing addresses) of the users. The Office of The Surgeon General (OTSG), Department of the Army, provided that information and authorized TROSCOM to communicate with the hospital commanders.

(2) The MUST system assessment team developed a questionnaire based on the guidelines listed in MG Pezdirtz' letter of 11 February 1975. Copies of the questionnaire were printed and mailed to the eighteen (18) MUST equipped hospitals in CONUS and Europe. (In accordance with the Surgeon General's instructions, the CONUS distributions were channeled through FORSCOM.) When two-thirds of the questionnaires had been returned, the assessment team members decided that they had a representative sample and began their evaluations.

(3) Copies of the completed questionnaires were mailed to MERADCOM, NARADCOM and TACOM. Each agency was requested to comment on the questionnaire responses pertinent to its mission.

(4) Team members visited MUST equipped hospitals at Ft. Bragg, Ft. Riley, Ft. Campbell, and Ft. Leonard Wood. These visits enabled team members to interview hospital personnel, so that they could identify specific user problems and recommend corrective actions.

(5) Depots with major MUST responsibilities were requested to provide information relating to the adequacy of Major Subordinate Command (MSC) support. Tobyhanna and Tooele are the primary depots supporting the MUST non-medical components. Both depots responded to the data request.

(6) Utilizing data in TROSCOM files to supplement the information indicated above, each team member developed his part of a briefing, which was presented to the TROSCOM Command Group by a member of the Systems Analysis Office.

b. GUIDELINE QUESTIONS. The briefing was keyed to the guidelines listed in MG Pezdirtz' letter of 11 February 1975, and to the depot data requirements indicated in para 2d of TWX, AMCMA-SF, dated 26 August 1975, subject: Red Team/System Assessment Program.

(1) Original Design Mission. The MUST was designed to provide a system incorporating:

(a) High mobility,

(b) Reduced deployment time,

(c) High reliability,

(d) Improved hospital efficiency,

(e) Controlled environment, and,

(f) Capability of maintaining all-weather hospital operations.

The elements of the MUST are packaged and configured to be acceptable to almost any mode of transportation, military or commercial. The original requirement was developed by OTSG and Combat Developments Command tc provide rapid deployment to any tactical, environmental, or geographical situation.

(2) Development Test and Operational Test (DT/OT) (Engineer and Service Test (DT/ST)) Results.

(a) The power unit and inflatable shelter were the only components to reveal deficiencies during DT/ST. Of thirteen (13) deficiencies for the power unit, only one remains unresolved. It concerns the operation of the air filter at low temperatures. MERADCOM has initiated an ECP to resolve the problem.

(b) The only deficiency disclosed for the inflatable shelter during the test involved the zippers breaking and wearing out during use. This deficiency is still unresolved and it will continue to be a problem, because of the design dependence on zippers. TROSCOM has tasked NARADCOM with developing a replacement fastener for the next generation of shelters.

(3) Initial Production Test (IPT) Results and Corrective Action Resulting from DT/OT (ET/ST).

(a) The reliability of the power unit was increased by incorporating three ECPs into the current procurement contract with Amertech Corp. The ECPs relate to:

1. The fuel control valve
2. The multi-speed switch
3. The turbine journal bearing.

Because of the excessive cost required to completely rework the GFE turbine, the first fifty (50) units will not incorporate the modification of the

turbine journal bearings. However, the remaining ninety-one (91) CFE units will include the modification. Likewise, units rebuilt at Tooele Army Depot will incorporate the modification.

(b) TROSCOM and MERADCOM are evaluating an unsolicited proposal, submitted by AiResearch Manufacturing Co., which maintains that power unit fuel usage could be reduced as much as 43% by means of a turbine recuperator. Other claimed advantages include reduced noise level and lower infrared signature.

(c) A current incomplete RAM evaluation of the expandable shelter at TECOM has disclosed problems relating to failures of the following:

1. Roof seals
2. Roof strut pinball locks.

An ECP for improved seals corrected the first problem. TROSCOM and NARADCOM are studying the second. Current field evaluation indicates that the Mean-Time-Between-Failure (MTBF) exceeds user requirements.

(d) In June 1975, TROSCOM released 629 units of the multi-purpose shelter with all deficiencies corrected. Test and field results exceed user RAM requirements.

(e) Current field evaluation indicates that the inflatable shelter satisfies user requirements. A user IPT, conducted by U.S. Army Medical Materiel Agency in 1974, did not address RAM, but it did test two shelters and a corridor connector manufactured respectively by Firestone Coated Fabrics Co. and Inflated Products, Inc. Corrective actions accomplished by ECP for future procurements include the following:

1. Reinforcement for sod cloth openings.

2. Provision for longer and shorter tie cords.

3. Positive means for holding window open.

4. Longer web loops for entryway.

5. Specification of circuit breaker with higher amperage.

6. Modification of light support straps.

7. Inclusion of procedures and adhesive for delamination repair.

8. Addition of replacement warning on light fixture.

9. Reversal of doors to open outward.

(4) Initial Field Performance. The MUST was first fielded in 1966 in Vietnam. Early reports indicate that the field performance was excellent. Early problems were corrected by contractor personnel in the field. Significant actions taken in response to EIRs include:

(a) For the power unit:

1. Redesign of exhaust plenum.

2. Redesign of inflation ejector.

3. Installation of a new bronze journal bearing.

4. Removal of deteriorating insulation and development of a new rain cover.

5. Evaluation of a new de-icing hood.

(b) For the expandable shelter:

1. Design change of honeycomb panel and corner brace with new repair procedures.

2. Installation of grease fittings on leveling jacks in the field, and design of new leveling jacks.

3. Dissemination of instructions to protect conductive flooring from damage caused by sliding bulk objects.

4. Ammendment of TM for proper door operation to prevent damage to weather stripping.

(c) For the multi-purpose shelter:

1. Design change of honeycomb panel with new repair procedures.

2. Installation of grease fittings on leveling jacks in the field, and design of new leveling jacks.

3. Ammendment of TM for proper door operation to prevent damage to weather stripping.

4. Preparation of instructions for installation of security hasp to be applied to folding door and roof hatch.

(d) For the inflatable shelter:

1. Provision for new zipper supplier, with installation assistance and revisions to TM to cover installation instructions and new NSNs.

2. Redesign of weather seal assembly.

3. Reversal of direction of door opening, to include new procurement action and preparation of instructions for fielded units.

(5) System Changes Since Original Fielding. There have been numerous changes to each of major components since originally fielded. Among them have been the following:

(a) To the power unit:

1. Installation of new improved fuel filter separator.

2. Modification of condenser compartment water drainage.

3. Installation of new improved fuel control unit.

(b) To the expandable shelter:

1. Specification of new "hot bond" process for manufacture of aluminum faced honeycomb side walls and roof panels.

2. Installation of new improved conductive flooring.

(c) To the multi-purpose shelter:

1. Installation of new improved vinyl coated flooring.

2. Installation of new improved lock pins for holding leveling jacks in up position during transport.

3. Construction of new improved fabric enclosure.

(d) To the inflatable shelter:

1. Construction of new improved web seam in each bladder compartment.

2. Reduction of setting for bladder pressure relief valve.

3. Increase in fire retardancy of material used throughout the shelter.

(6) Field Performance Today. Responses in the user questionnaire indicate that the non-medical MUST components are performing adequately during field exercises. The Martin-Marietta Co. used four inflatable shelters at a Safeguard missile site in North Dakota over a three-year period. During that time outside temperatures varied from -40°F. to +95°F. Inside the temperature was maintained at 90° $\pm$ 10°F. Repairs were minimal. Martin-Marietta was very pleased with the shelters' performance.

(7) Field User Opinion of the System. The questionnaires returned from MUST hospitals indicate that the non-medical MUST components are satisfactory.

(8) Current Problems:

(a) Performance (RAM). The RAM field performance of the non-medical MUST components when utilized as a system fails to meet the minimum user requirement. This failure is attributed to the power unit. Low field usage and limited user repair capability contributed to the problem. Recommendations to improve the RAM performance of the system are:

1. Establishment of a user's maintenance team.

2. Establishment of a specific MUST maintenance military occupational specialty (MOS).

3. Application of life cycle cost model technique to power unit (a copy of RISE Program, Phase I, for the utility power unit is attached as Appendix C).

4. Standardization of zippers used on the inflatable shelter to insure compatibility.

(b) Operational readiness. There are no known or reported shortages of major MUST components; therefore, MUST hospitals are not part of the operational readiness program. Through FY 77, 42 hospitals (30 Combat Support and 12 Evacuation) have been scheduled for procurement. There is no funded program for complete hospitals after FY 77.

(c) Manuals and Training:

1. Users indicate that the manuals provide adequate coverage for the MUST system for operation, maintenance, and repair parts support. Problems were identified to outdated or missing repair procedures, and missing National Stock Numbers. Corrective actions include addition of new repair procedures, and assignment of new NSNs and part numbers.

2. The training afforded to troops by Army and contractor schools is adequate. The major problem lies in the units' ability to maintain their authorized strengths of trained personnel.

(d) Maintenance, Supply, and Safety:

1. Maintenance problems are attributed to:

a. Lack of qualified maintenance personnel,

b. Obsolete repair procedures in TMs, and

c. Discontinued production of replacement parts.

To meet those situations the following respective actions have occurred: Medical personnel have performed maintenance functions on non-medical MUST components; TMs in preparation incorporate new state-of-the-art repair techniques; and alternate manufacturers have been found for replacement parts.

2. There is no report of any MUST unit failing to be operational because of the lack of repair parts.

3. Corrective actions to safety problems include:

a. Replacement of quick disconnect couplings on the power units bleed air hose with flare fittings.

b. Removal of noise insulation from the intake plenums of the power unit.

c. Retrofit of a redesigned drain tube to the power unit.

d. Requirement of additional fire retardant treatment for the floors, walls, and end panels of the inflatable shelter.

e. Reversal of exit door opening of inflatable shelter to open outward.

f. Authorization for additional quantities and more versatile types of fire extinguishers for inflatable shelter.

The new tech data package for ongoing contracts incorporates all the indicated safety changes except that for fire extinguishers.

(e) Technical Support. The survey of MUST users indicates that technical support is adequate. TROSCOM and NARADCOM personnel periodically visit posts, camps, and stations to provide technical assistance

(f) Stockpile Reliability and Special Facilities. Depot storage problems include:

1. Improper fork lifting.

2. Improper storage.

3. Limited test facilities.

The first two problems have caused shelter damage, and the last has had a detrimental effect on the depot's ability to check items before shipment. TROSCOM elements are working with the depots to resolve these problems.

(g) Foreign Sales and International Marketability. Canada is the only foreign nation that has indicated a desire for MUST equipment. Power units and multi-purpose shelters have been delivered to Canada; equipment on loan includes expandable, multi-purpose, and inflatable shelters. These components were lent to facilitate training.

(9) Depot Evaluations of MSC Support. Tobyhanna and Tooele are the primary depots supporting the non-medical MUST components. Both depots were queried with respect to MSC support. The following summarizes their evaluations.

(a) Rebuild instructions are adequate. Where revisions to manuals are pending, TROSCOM has provided supplemental instructions.

(b) Lack of some repair parts has caused minor problems. Where necessary, parts have been locally purchased or fabricated.

(c) Rebuild facilities at both depots are adequate.

(d) Training for MUST repair and rebuild is satisfactory. Tooele is the prime depot for the power unit. At Tobyhanna, most MUST repair training is oriented toward the other non-medical componets.

(10) Overall Assessment:

(a) Both positive and negative factors of the MUST are considered in making an overall assessment. Major factors addressed include the following:

1. Positive:

a. High mobility.

b. High reliability.

c. Quick deployment.

d. Controlled internal environment.

e. All weather operational capability.

f. Application to either combat conditions or civilian emergencies.

g. Facilities adequate for quality patient care.

h. Hardware problems either resolved or being resolved by responsible development commands.

2. Negative:

a. High fuel consumption by the power unit.

b. Freezing of power unit air filter at low temperatures.

c. Easily damaged floor in the expandable shelter.

d. Incompatibility of replacement with original zippers used in the inflatable shelter.

e. Influence of low usage on RAM system performance.

f. High procurement costs, making system vulnerable to funding cutbacks.

(b) Of the negative factors, responsible development commands either have resolved or are in the process of resolving all hardware problems. Department of the Army is aware of the problem of vulnerability to funding cutbacks.

(c) On balance, the positive factors prevail. Therefore, of the alternatives offered for consideration, "Fix the total problem" is selected.

SECTION III

3. FINDINGS AND CONCLUSIONS. This assessment finds that the non-medical MUST components provide facilities for quality medical care. They clearly perform their intended missions, and should be retained in the Army inventory.

APPENDIX A

SYSTEM ASSESSMENT

MEDICAL UNIT, SELF-CONTAINED, TRANSPORTABLE

NON-MEDICAL COMPONENTS

(MUST-NMC)

CHART 1L ON CHART 1R ON

GENERAL STERLING:

I AM AUBREY YAWITZ OF THE SYSTEMS ANALYSIS OFFICE.

THIS ASSESSMENT ADDRESSES THE NON-MEDICAL COMPONENTS OF THE MEDICAL UNIT, SELF-CONTAINED, TRANSPORTABLE, OTHERWISE CALLED THE MUST.

CHART 1L OFF CHART 1R OFF

WE HAVE SELECTED A SHORT TRAINING FILM, TF 8-4935, TO ILLUSTRATE HOW THE MUST FUNCTIONS.

(SHOW TF 8-4935)

CHART 2L ON

THIS CHART IDENTIFIES THE PRINCIPAL FIELDED NON-MEDICAL MUST HARDWARE ITEMS, MANAGED BY TROSCOM. PICTURES ON THE RIGHT ILLUSTRATE:

CHART 2R ON

THE POWER UNIT, UTILITY. IT PROVIDES ELECTRICAL POWER IN 400 AND 60 HZ FREQUENCIES, AIR CONDITIONING, HEATING, WATER HEATING AND CIRCULATION, COMPRESSED AIR,AND SUCTION FOR HOSPITAL USE. IT IS GAS TURBINE OPERATED, AND VERSATILE IN FUELS; IT CAN OPERATE ON STANDARD AVIATION GAS, AUTOMOBILE GAS, COMMERCIAL DIESEL FUEL OR KEROSENE. ITS PRIMARY FUEL IS JP-4.

CHART 2R OFF

CHART 3R ON

THE SHELTER, EXPANDABLE.

THIS SHELTER PROVIDES A CONTROLLED ENVIRONMENT FOR SURGERIES, LABORATORIES, PHARMACIES, OR X-RAY FACILITIES. IT IS AN EXPANDABLE STRUCTURE CONSTRUCTED OF ALUMINUM-FACED, FOAM-FILLED, HONEYCOMB PANELS. AN AIRLOCK CHAMBER OVER THE DOOR RESTRICTS THE MOVEMENT OF AIR AND DUST INTO THE SHELTER.

CHART 3R OFF

CHART 4R ON

THE SHELTER, MULTIPURPOSE.

THIS SHELTER FUNCTIONS PRIMARILY AS THE SHIPPING AND STORAGE CONTAINER FOR THE INFLATABLE SHELTER AND SET-UP EQUIPMENT. WHEN NOT USED FOR TRANSPORT IT CAN FULFILL SEVERAL SECONDARY FUNCTIONS INCLUDING THOSE OF AID STATION, AND LINEN EXCHANGE. THIS SHELTER UTILIZES A FABRIC WALL INCLOSURE TO INCREASE ITS SPACE WHEN EXPANDED. LIKE THE EXPANDABLE SHELTER, IT IS CONSTRUCTED OF ALUMINUM-FACED, FOAM-FILLED, HONEYCOMB PANELS.

CHART 4R OFF

CHART 5R ON

THE SHELTER, INFLATABLE.

THIS SHELTER IS A DUAL WALL FABRIC STRUCTURE FORMED BY AIR PRESSURE PROVIDED BY THE UTILITY POWER UNIT IN A FABRIC TUBE BLADDER THAT SUPPORTS THE WALLS AND ROOF. IT SERVES PRIMARILY AS A PATIENT WARD, WITH SECONDARY FUNCTIONS FOR FOOD SERVICE MESS, DISPENSARY OPERATIONS, OR PATIENT REGULATING.

CHART 5R OFF

THE DEVELOPMENT OF THE FOOD SERVICE COMPLEX HAS BEEN TERMINATED BY THE SURGEON GENERAL BECAUSE THE PROTOTYPE WAS TOO HEAVY, TOO COMPLEX AND COST WAS TOO HIGH. THE OTSG HAS REQUESTED DARCOM TO ACCEPT DEVELOPMENT RESPONSIBILITY OF A FOOD SERVICE COMPLEX TO MEET THE REQUIREMENTS OF THE MUST HOSPITAL.

A FORMAL IN-PROCESS REVIEW (IPR) WAS HELD AT FORT DETRICK, MD, 22 MAR 76 ON THE LAVATORY AND SHOWER UNITS OF THE WATER AND WASTE MANAGEMENT COMPLEX. OPERATIONAL TEST II (DT II) WILL CONTINUE AS SCHEDULED. A DEVELOPMENT TEST III (DT III) WILL BE SCHEDULED TO EVALUATE THE ENGINEERING CHANGES AND MAINTENANCE CRITERIA THAT HAVE TAKEN PLACE SINCE DT II BY THE US ARMY GENERAL EQUIPMENT TEST ACTIVITY (GETA).

CHART 2L OFF

CHART 3L ON

THIS CHART INDICATES THE QUANTITIES OF MAJOR COMPONENTS PRESENTLY REQUIRED TO EQUIP COMBAT SUPPORT AND EVACUATION HOSPITALS.

CHART 3L OFF .

CHART 4L ON

IN ADDITION TO RESEARCH IN THE TROSCOM FILES, OUR DATA SEARCH INCLUDED THE FOLLOWING EFFORTS:

QUESTIONNAIRES, DEVELOPED BY TROSCOM TEAM MEMBERS, WERE MAILED TO EACH MUST EQUIPPED HOSPITAL, SO IDENTIFIED BY THE SURGEON GENERAL.

MEMBERS OF THE ASSESSMENT TEAM VISITED MUST EQUIPPED HOSPITALS AT THE INDICATED ARMY POSTS.

MERADCOM AND NARADCOM HAVE DEVELOPMENT RESPONSIBILITIES IN THE MUST. BOTH HAVE BEEN CONTACTED FOR COMMENTS TO FIELD USERS REMARKS.

DEPOTS WITH MAJOR MUST RESPONSIBILITIES HAVE LIKEWISE BEEN CONTACTED IN COMPLIANCE WITH ANDARCOM MESSAGE SUPPLEMENTING THE ORIGINAL SYSTEM ASSESSMENT INSTRUCTIONS.

THE OFFICE OF THE SURGEON GENERAL PROVIDED THE AUTHORITY TO MAIL QUESTIONNAIRES TO THE USING HOSPITALS. CONUS HOSPITALS' QUESTIONNAIRES WERE CHANNELLED (COMING AND GOING) THROUGH FORSCOM HEADQUARTERS. BOTH THE SURGEON GENERAL AND FORSCOM RECEIVED INFORMATION COPIES OF THE QUESTIONNAIRE.

THE DEFENSE LOGISTICS STUDIES INFORMATION EXCHANGE PROVIDED REFERENCE INFORMATION FOR THE ASSESSMENT.

THE TROSCOM INTERNAL REVIEW AND AUDIT DIVISION REPORTS THAT THERE HAS NEVER BEEN AN EXTERNAL AUDIT OF THE NON-MEDICAL COMPONENTS OF THE MUST SYSTEM.

CHART 4L OFF

CHART 5L ON CHART 6R ON

THE ORIGINAL DARCOM GUIDELINES ARE ADDRESSED BY THE TROSCOM STAFF ELEMENTS INDICATED ON THESE CHARTS.

CHART 5L OFF CHART 6R OFF

CHART 6L ON

IN LATER INSTRUCTIONS FROM DARCOM, WE WERE DIRECTED TO INCLUDE A DEPOT EVALUATION. THE DIRECTORATE OF MAINTENANCE HAS THAT PRIMARY RESPONSIBILITY.

CHART 6L OFF

CHART 7L ON CHART 7R ON

RECOGNIZING THE NEED FOR IMPROVED FIELD HOSPITAL FACILITIES, THE U. S. ARMY MEDICAL SERVICE BEGAN AN IMPROVEMENT INVESTIGATION IN 1947. THE RESOLUTION OF THIS REQUIREMENT WAS UNDERTAKEN BY THE SURGEON GENERAL IN 1962. THE RESULTS OF THIS INVESTIGATION WERE IDENTIFIED IN 1963 WHEN THE GARRETT CORP. UNDERTOOK A DEVELOPMENT PROGRAM FOR A NEW CONCEPT IN MILITARY FIELD HOSPITALS. THIS DEVELOPMENT PROGRAM ESTABLISHED THE BASIC FEATURES OF THE MUST COMPLEX, AND PROVIDED A SYSTEM WHICH INCORPORATED HIGH MOBILITY, REDUCED DEPLOYMENT TIME, HIGH RELIABILITY, IMPROVED EFFICIENCY, CONTROLLED ENVIRONMENT, AND THE CAPABILITY OF MAINTAINING ALL-WEATHER HOSPITAL OPERATIONS. DURING THE 1966-1967 TIME PERIOD, DARCOM ASSUMED SUPPORT AND COMMODITY MANAGEMENT RESPONSIBILITY FOR THE MUST SYSTEM.

DARCOM ASSIGNED TROSCOM AS THE RESPONSIBLE SUBORDINATE COMMAND, AND THE DEVELOPMENT ACTIVITIES OF MERADCOM AND NARADCOM WERE ASSIGNED RD&E RESPONSIBILITIES. MERADCOM WAS ASSIGNED THE UTILITY ELEMENT, AND NARADCOM THE INFLATABLE, EXPANDABLE, AND MULTI-PURPOSE SHELTERS.

A PROTOTYPE HOSPITAL WAS DEMONSTRATED AT FT. SAM HOUSTON, TX, IN FEBRUARY 1965. AS A RESULT OF THIS DEMONSTRATION, LIMITED PRODUCTION UNITS WERE DEPLOYED TO SOUTH EAST ASIA (SEA) IN 1966 AND 1967, WHERE AN OPERATIONAL TEST WAS PERFORMED.

TROSCOM AUTHORIZED LIMITED PRODUCTION STATUS TO MEET URGENT SEA REQUIREMENTS UNTIL SATISFACTORY ENGINEERING AND SERVICE TESTS, CONDUCTED IN 1969, VERIFIED THAT THE DESIGN WAS ACCEPTABLE.

THE ELEMENTS OF THE MUST ARE PACKAGED AND CONFIGURED, SO THAT THEY ARE ACCEPTABLE TO ALMOST ANY MODE OF TRANSPORTATION, MILITARY OR COMMERCIAL.

THE ORIGINAL REQUIREMENT WAS DEVELOPED BY THE OFFICE OF THE SURGEON GENERAL AND THE COMBAT DEVELOPMENTS COMMAND TO PROVIDE RAPID DEPLOYMENT TO ANY TACTICAL, ENVIRONMENTAL, AND GEOGRAPHICAL SITUATION.

CHART 7L OFF CHART 7R OFF

CHART 8L ON CHART 8R ON

THIS CHART DISPLAYS THE RESULTS OF THE DEVELOPMENT AND OPERATIONAL TESTS PERFORMED ON THE MUST COMPONENTS.

CHART 8L OFF CHART 8R OFF

CHART 9L ON

ALL DEFICIENCIES IDENTIFIED DURING THE ENGINEERING AND SERVICE TESTS WERE CORRECTED OR RESOLVED EXCEPT THOSE RELATING TO THE UTILITY ELEMENT AND THE INFLATABLE SHELTER. THE UNRESOLVED DEFICIENCIES ARE INDICATED ON THIS CHART. OF 13 DEFICIENCIES REVEALED DURING THE TEST OF THE UTILITY ELEMENT, ONLY ONE REMAINS UNRESOLVED. IT CONCERNS THE OPERATION OF THE AIR FILTER AT LOW TEMPERATURES. MERADCOM HAS INITIATED AN ECP TO RESOLVE THIS PROBLEM. THE INFLATABLE SHELTER HAS ONE UNCORRECTED DEFICIENCY WHICH WAS THE ONLY DEFICIENCY NOTED DURING TEST. THIS DEFICIENCY WAS ATTRIBUTED TO ZIPPERS BREAKING AND WEARING OUT DURING USE. IT WILL CONTINUE TO BE A PROBLEM DUE TO DESIGN DEPENDANCE ON ZIPPERS.

FOR THE NEXT GENERATION OF SHELTERS, TROSCOM HAS TASKED NARADCOM WITH DEVELOPING A REPLACEMENT FASTENER.

CHART 9L OFF

CHART 10L ON CHART 9R ON

THIS CHART COMPARES USER REQUIREMENTS WITH INITIAL PRODUCTION TEST AND FIELD RESULTS.

A. THE UTILITY ELEMENT PROCURED UNDER THE CURRENT CONTRACT WITH AMERTECH CORP., INCORPORATES THREE ECP'S TO INCREASE THE RELIABILITY OF THE UNIT. THESE ECP'S ADDRESS THE THREE MAJOR FAILURE MODES EVIDENCED DURING THE INITIAL PRODUCTION TEST ON THE PRIOR CONTRACT WITH THE LIBBY WELDING CO.

THE ECP'S RELATED TO:

1. THE FUEL CONTROL VALVE
2. THE MULTI-SPEED SWITCH
3. THE TURBINE JOURNAL BEARING.

INCORPORATION OF THESE CHANGES WILL INCREASE THE MEAN TIME BETWEEN FAILURES TO THE USER REQUIREMENT.

THE FIRST 50 UNITS WILL NOT INCORPORATE THE MODIFICATION OF THE TURBINE JOURNAL BEARINGS, BASED ON THE EXCESSIVE COST REQUIRED TO COMPLETELY REWORK THE GFE TURBINE; HOWEVER, THE LAST 91 CFE UNITS WILL INCORPORATE THIS MODIFICATION.

LIKEWISE, UNITS REBUILT AT TOOELE ARMY DEPOT WILL INCORPORATE THE MODIFICATION. THE FINAL AMERTECH RELIABILITY TEST REPORT IS EXPECTED BY JULY 1976.

THERE ARE SEVERAL OTHER AREAS UNDER IMPROVEMENT CONSIDERATION AT THE PRESENT TIME.

TROSCOM AND MERADCOM ARE TAKING STEPS TO REDUCE THE FUEL CONSUMPTION OF THE UTILITY ELEMENT THROUGH AN EVALUATION OF AN UNSOLICITED PROPOSAL SUBMITTED BY AIRESEARCH MFG. CO. THROUGH THE USE OF A TURBINE RECUPERATOR, SAVINGS AS HIGH AS 43% OF THE CURRENT FUEL CONSUMPTION ARE ESTIMATED. ALSO FORECAST ARE REDUCED NOISE LEVEL, REDUCED INFRARED SIGNATURES, INCREASED RELIABILITY, AND DECREASED LOGISTICS COST. TROSCOM ELEMENTS ARE CURRENTLY EVALUATING THE PROPOSAL FOR PROGRAM FEASIBILITY. COST FACTORS AND BREAKEVEN POINTS HAVE NOT YET BEEN ESTABLISHED.

B. THE EXPANDABLE SHELTER IS CURRENTLY UNDERGOING A RAM EVALUATION AT TECOM. THE TEST IS APPROXIMATELY 70% COMPLETE. RELEASE IS CURRENTLY FORECAST FOR MAY 1976. TWO SIGNIFICANT PROBLEMS HAVE OCCURRED TO DATE. THE FIRST, INVOLVING ROOF SEALS, HAS BEEN CORRECTED BY ECP WITH IMPROVED SEALS. THE SECOND PROBLEM RELATES TO THE FAILURE OF THE ROOF STRUT PINBALL LOCK. TROSCOM IS CONTINUING ITS EFFORTS WITH NARADCOM TO RESOLVE THESE TEST PROBLEMS. CURRENT FIELD EVALUATION INDICATES THAT THE MTBF EXCEEDS USER REQUIREMENTS.

C. THE MULTI PURPOSE SHELTER WAS INITIAL PRODUCTION TESTED IN MARCH 1975. SIX HUNDRED TWENTY NINE UNITS WERE RELEASED BY TROSCOM IN JUNE 1975, WITH ALL DEFICIENCIES CORRECTED. TEST AND FIELD RESULTS EXCEED USER RAM REQUIREMENTS.

D. CURRENT FIELD EVALUATION INDICATES THAT THE INFLATABLE SHELTER SATISFIES USERS' RAM REQUIREMENTS. A USER INITIAL PRODUCTION TEST, CONDUCTED BY THE U. S. ARMY MEDICAL MATERIEL AGENCY, AT FT. SAM HOUSTON, TX. IN 1974 DID NOT ADDRESS RAM. HOWEVER, TWO SHELTERS, EACH CONSISTING

OF FOUR SHELTER SECTIONS AND A CORRIDOR CONNECTOR WERE TESTED. THE SHELTERS WERE MANUFACTURED BY FIRESTONE COATED FABRICS CO., AND THE INFLATABLE CORRIDOR CONNECTOR BY INFLATED PRODUCTS, INC.

CHART 9R OFF
CHART 10R ON

THE TEST AGENCY REPORTED NINE (9) SIGNIFICANT PROBLEMS. THE CORRECTIVE ACTIONS ARE SHOWN ON THIS CHART. THE TDP HAS BEEN CORRECTED FOR FUTURE PROCUREMENTS. A USER FIELD TEST WAS AUTHORIZED FOR CORRIDOR CONNECTORS AND 14 FOOT PASSAGEWAYS PRODUCED BY

INFLATED PRODUCTS CORP. TROSCOM'S EVALUATION OF TEST RESULTS WILL BE FINALIZED ON RECEIPT OF NARADCOM'S INPUT. THE COMPLETED EVALUATION WILL BE FORWARDED TO THE LEGAL OFFICE FOR DETERMINATION.

CHART 10L OFF CHART 10R OFF

CHART 11L ON

THE UNITS WERE FIRST FIELDED IN NOVEMBER 1966 IN VIETNAM. EARLY REPORTS FROM 45TH SURGICAL HOSPITAL NEAR TYA NINH REVEALED THAT THE MUST FIELD PERFORMANCE WAS EXCELLENT.

MINOR DEFECTS AND EQUIPMENT FAILURES OCCURRED AS MIGHT BE EXPECTED WHEN FIELDING A NEW SYSTEM IN THE HARSH ENVIRONMENT OF VIETNAM. THESE MINOR DEFECTS, HOWEVER, DID NOT RESTRICT THE MEDICAL OPERATION OF THE SYSTEM.

EARLY DISCREPANCIES WERE CORRECTED BY CONTRACTOR PERSONNEL IN VIETNAM AND CONSISTED OF EITHER REPAIRING MINOR DEFECTS ON THE SPOT OR BY MODULAR COMPONENT REPLACEMENT. SIGNIFICANT DISCREPANCIES REPORTED BY EIR'S WITH CORRECTIVE ACTIONS ARE AS FOLLOWS:

CHART 11R ON

A TOTAL OF 18 EIR'S WERE SUBMITTED DURING THE PERIOD 1972-1975 ON THE POWER PLANT UTILITY. ALL OF THESE EIR'S ARE CONSIDERED TO BE DESIGN DEFICIENCIES.

CHART 11R OFF

CHART 12R ON

EIGHT EIR'S WERE SUBMITTED ON THE SHELTER EXPANDABLE DURING THE PERIOD 1972 THROUGH 1975. SIX OF THESE EIR'S ARE CONSIDERED DESIGN DEFICIENCIES AND ONE EIR IS RELATED TO OPERATOR INDUCED DEFICIENCY. ONE EIR RESULTED FROM INADEQUATE OPERATION INSTRUCTIONS IN THE TM.

CHART 12R OFF

CHART 13R ON

A TOTAL OF 8 EIR'S WERE SUBMITTED ON THE SHELTER MULTI-PURPOSE SINCE 1972. SEVEN OF THESE EIR'S WERE CONSIDERED TO BE DESIGN DEFICIENCIES AND ONE EIR RESULTED FROM INADEQUATE OPERATION INSTRUCTIONS IN THE TM.

CHART 13R OFF

CHART 14R ON

SIX EIR'S WERE SUBMITTED ON THE SHELTER INFLATABLE. ALL SIX OF THESE EIR'S ARE CONSIDERED DESIGN DEFICIENCIES.

CHART 11L OFF

CHART 14R OFF

CHART 12L ON

UTILITY POWER PLANT:

SINCE THE UTILITY POWER UNIT WAS ORIGINALLY FIELDED IN 1966 IN SOUTH EAST ASIA TWO PRODUCTION CONTRACTS WERE AWARDED TO THE LIBBY WELDING CO. TWO MORE PRODUCTION CONTRACTS ARE CURRENTLY IN PROGRESS WITH THE AMERTECH CORP., PHOENIX, AZ. NUMEROUS PROBLEMS WERE ENCOUNTERED DURING IPT TESTING OF THE LIBBY WELDING CONTRACTS. CORRECTIONS TO THE PROBLEMS ARE DISPLAYED ON THE CHART.

CHART 15R ON

CHART 15R OFF

EXPANDABLE SHELTER

IN 1972, A THREE YEAR, MULTI-YEAR CONTRACT WAS AWARDED TO BRUNSWICK CORP. FOR PROCUREMENT OF 184 EXPANDABLE SHELTERS. AS A RESULT OF DESIGN DISCREPANCIES, MANY PROBLEMS, INVOLVING APPROXIMATELY 200 ECP'S WERE ENCOUNTERED DURING THE OUTSET OF THIS CONTRACT. THROUGH THE COMBINED EFFORTS OF BRUNSWICK CORP. AND NARADCOM, CHANGES WERE MADE TO THE ORIGINAL DESIGN. THEY ARE AS DEPICTED ON THE CHART.

CHART 16R ON

CHART 16R OFF

MULTI-PURPOSE SHELTER

THIS SHELTER IS BASICALLY THE SAME DESIGN AS THE ORIGINAL WITH THE EXCEPTION OF THE FABRIC ENCLOSURE, WHICH WAS COMPLETELY REDESIGNED BY NARADCOM. DURING ONE OF THE EARLY PRODUCTION CONTRACTS (WITH MISSOURI RESEARCH LABS) MUCH DIFFICULTY WAS ENCOUNTERED IN THE MANUFACTURE OF THE HONEYCOMB ALUMINUM-FACED WALL AND ROOF PANELS. DELAMINATION OCCURRED WHEN THE ALUMINUM SKIN PULLED AWAY FROM THE EPOXY ATTACHED PAPER HONEYCOMB. A COLD BOND PROCESS HAD BEEN USED. SINCE THAT TIME, ON CURRENT CONTRACTS WITH BRUNSWICK CORP., A NEW HOT BOND PROCESS, DEVELOPED BY NARADCOM AND BRUNSWICK, IS USED WITH SATISFACTORY RESULTS. DISPLAYED ON THE CHART ARE THE SIGNIFICANT CHANGES SINCE ORIGINAL FIELDING.

CHART 17R ON

CHART 17R OFF

INFLATABLE SHELTER.

NUMEROUS PROBLEMS OCCURRED DURING PREPRO AND EARLY PRODUCTION IN JUNE 1973, LARGELY AS A RESULT OF DESIGN DEFICIENCIES. FROM JUNE 1973 THROUGH OCTOBER 1973 THE PROBLEMS WERE RESOLVED THROUGH THE JOINT EFFORTS OF TROSCOM ELEMENTS, NARADCOM AND THE CONTRACTOR, FIRESTONE COATED FABRICS CO. CORRECTIONS TO THE MAJOR PROBLEMS WERE IN THE AREAS DISPLAYED ON THE CHART.

CHART 18R ON

CHART 12L OFF

CHART 18R OFF

CHART 13L ON

THE MUST EQUIPMENT SYSTEM IS THE FIRST CONCERTED EFFORT TO IMPROVE THE ENTIRE FIELD MEDICAL SERVICE SYSTEM. BASED ON REPLIES FROM USER QUESTIONNAIRES RECEIVED IN NOVEMBER 1975, THE CURRENT MUST SYSTEM IS PERFORMING ADEQUATELY. THE ONLY AVAILABLE FIELD USAGE STATISTICS COMPILED FROM THESE USER REPORTS ARE SHOWN ON THIS CHART.

CHART 19R ON

MARTIN-MARIETTA CO. PROVIDED PERFORMANCE INFORMATION ABOUT THE INFLATABLE SHELTERS USED IN THE SAFEGUARD SYSTEM AT THE STANLEY R. MICKELSON SAFEGUARD SITE IN NORTH DAKOTA. FOUR INFLATABLE SHELTERS WERE USED AT THE SITE OVER THE PERIOD OF JUNE 1973 TO MAY 1976. OUTSIDE TEMPERATURES RANGED FROM -40°F TO + 95°F. INSIDE THE SHELTERS THE TEMPERATURE RANGE WAS MAINTAINED AT 80°F PLUS OR MINUS 10°. IN ADDITION TO THE EXTREME TEMPERATURES, VERY HIGH WINDS WERE ENCOUNTERED. DURING THE PERIOD, 3 BLADDERS (OF APPROXIMATELY 50) REQUIRED REPLACEMENT. NEEDLESS TO SAY, THE MARTIN-MARIETTA PEOPLE WERE VERY PLEASED WITH THE INFLATABLE SHELTERS' PERFORMANCE.

CHART 13L OFF

CHART 19R OFF

CHART 14L ON

AGAIN BASED ON THE AFOREMENTIONED USER SURVEY, THE MUST NON-MEDICAL SYSTEM COMPONENTS ARE SATISFACTORY. IT IS THE OPINION OF THE OFFICE OF THE SURGEON GENERAL BASED ON EXPERIENCE IN VIETNAM THAT THE RESULTS OF THE SYSTEM THUS FAR CLEARLY INDICATE THAT A TREMENDOUS ADVANCE HAS BEEN MADE IN PRESERVING LIFE AND HEALTH FOR THE COMBAT SOLDIER.

CHART 14L OFF

CHART 15L ON CHART 20R ON

THIS CHART SUMMARIZES THE RAM PERFORMANCE OF THE MUST NON-MEDICAL COMPONENTS, WHEN UTILIZED AS A SYSTEM.

THE RAM FIELD RESULTS PROVIDE A COMPARATIVE ANALYSIS OF REQUIREMENTS AND RESULTS OF DEVELOPMENTAL TESTING TOGETHER WITH RESULTS OF THE FIELD EVALUATION.

CURRENT PROCUREMENT SPECIFICATIONS FOR THE EXPANDABLE, MULTI-PURPOSE, AND INFLATABLE SHELTERS DO NOT INCLUDE QUANTITATIVE RAM PROVISIONS. TROSCOM, NARADCOM, AND THE SURGEON GENERAL ARE CONTINUING THEIR EFFORTS TO RESOLVE THE QMR REQUIREMENTS TO INSURE THAT THE USER'S LOGISTICS BURDEN IS ADEQUATELY DEFINED IN THE PROCUREMENT DOCUMENTS AND THAT QMR TRACEABILITY IS INCLUDED IN ALL SPECIFICATIONS.

THE FIELD VISITS AND QUESTIONNAIRES ENABLED THE ASSESSMENT TEAM TO IDENTIFY USER PROBLEMS IMPACTING THE RAM EVALUATION.

THE FAILURE OF FIELD RESULTS TO MEET USER REQUIREMENTS IS ATTRIBUTED TO LOW FIELD USAGE AND LIMITED USER REPAIR CAPABILITY. THE UTILITY ELEMENT, WITH AN AVERAGE USAGE OF 53 HOURS PER MONTH, IS LARGELY RESPONSIBLE FOR THAT CONDITION.

CHART 20R OFF

CHART 21R ON

SPECIFIC RECOMMENDATIONS FOR RAM IMPROVEMENT ARE DISPLAYED ON THE RIGHT. THESE RECOMMENDATIONS ARE DESIGNED TO INCREASE OPERATIONAL UNIT EFFECTIVENESS.

A SPECIALIZED MAINTENANCE TEAM WOULD PROVIDE THE CAPABILITY FOR ON-SIGHT REPAIR ASSISTANCE, AND WOULD ASSIST IN ON-THE-JOB TRAINING.

A SPECIFIC MOS WOULD LEAD TO SPECIALLY TRAINED MAINTENANCE PERSONNEL. THE SPECIALIZED TRAINING IN TURN WOULD REDUCE DOWNTIME OF MUST COMPONENTS.

AN APPLICATION OF THE RAM LIFE CYCLE COST MODEL IS BEING ANALYZED. IT IS IN THE PHASE I IDENTIFICATION STAGE, AWAITING AN ENGINEERING ANALYSIS.

THE INCOMPATIBILITY OF INFLATABLE SHELTER PARTS HAVING OLD ZIPPERS WITH THOSE HAVING NEW ONES HAS CREATED AN OBVIOUS PROBLEM. NARADCOM AND TROSCOM DIRECTORATES FOR MAINTENANCE AND FOR PRODUCT ASSURANCE ARE STUDYING THE PROBLEM IN SEARCH OF AN OPTIMUM SOLUTION.

CHART 15L OFF CHART 21R OFF

CHART 16L ON

CHART 22R ON

THIS CHART SHOWS THE TOTAL NUMBER OF COMBAT SUPPORT AND EVACUATION HOSPITALS REQUIRED WITH CURRENT ASSETS AND SHORTAGES. THESE HOSPITALS ARE NOT PART OF THE OPERATIONAL READINESS PROGRAM. THERE ARE NO KNOWN OR REPORTED FIELD PROBLEMS OR SHORTAGES. THROUGH THE FISCAL YEAR 77 FUNDED DELIVERY PERIOD, ALL ACTIVE ARMY, ALL NATIONAL GUARD, AND EIGHT RESERVE HOSPITALS WILL BE SATISFIED, LEAVING A BALANCE OF 24 HOSPITALS TO BE PROCURED. THESE SHORTAGES FALL INTO FORCE ACTIVITY 4 AND 5. BASED UPON THEIR LOW URGENCY OF ACQUISITION PRIORITY, THEY WERE DEFERRED FOR ACQUISITION BY DEPARTMENT OF THE ARMY FOR THE DURATION OF THE PRESENT FIVE YEAR DEFENSE PLAN.

CHART 22R OFF

CHART 23R ON

THIS CHART SHOWS THE AUTHORIZED ACQUISITION OBJECTIVE (AAO) FOR EACH ITEM WHICH MAKES UP A HOSPITAL. WORLDWIDE ASSETS ON HAND, PLUS DUE IN THROUGH THE FY77 PROGRAM LESS LOSSES FORECASTED THROUGH THE FUNDED DELIVERY PERIOD, MAKE UP TOTAL ASSETS. THIS PROGRAM WILL SUPPORT AND FIELD 42 HOSPITALS ADDRESSED ON THE PRECEDING CHART.

CHART 23R OFF

CHART 24R ON

THIS CHART DISPLAYS THE PROCUREMENT SCHEDULE THROUGH FY77 FOR 42 HOSPITALS. AS MENTIONED PREVIOUSLY, THERE IS NO FUNDED PROGRAM FOR COMPLETE HOSPITALS AFTER FY77. A TOTAL OF 23.2 MILLION DOLLARS IN FY81 HAS BEEN FUNDED TO PROCURE MAJOR HOSPITAL COMPONENTS IN SUPPORT OF WASHOUTS AND CONSUMPTION.

CHART 24R OFF

CHART 25R ON

THIS CHART INDICATES THE AGE OF ASSETS CURRENTLY IN THE SYSTEM. THE LIFE EXPECTANCY IS BASED ON ENGINEERING ESTIMATES RATHER THAN ON FULL SCALE USAGE. EXCEPT FOR LIMITED FIELD TESTING DURING THE VIETNAM WAR, THE DEPLOYED HOSPITALS HAVE BEEN UTILIZED FOR TRAINING PURPOSES ON A PART TIME BASIS ONLY. TWENTY-SIX SHELTERS, 5 SECTION, WILL WASHOUT AS OVER AGE IN FY78. WHEN PROJECTING WASHOUTS OF OVER AGE ASSETS, CONSIDERATION WAS GIVEN TO THE DIFFERENCE BETWEEN TRAINING USAGE AND FULL TIME USAGE. THE AGE LIFE OF THE POWER UNIT HAS BEEN EXTENDED FROM 10 TO 20 YEARS.

CHART 16L OFF

CHART 25R OFF

CHART 17L ON CHART 26R ON

THESE CHARTS INDICATE THE MANUALS AVAILABLE AND IN PREPARATION AT THIS TIME.

CHART 17L OFF CHART 26R OFF

CHART 18L ON CHART 27R ON

USERS INDICATE THAT THE MANUALS PROVIDE ADEQUATE COVERAGE FOR THE MUST SYSTEM FOR OPERATION, MAINTENANCE, AND REPAIR PARTS SUPPORT. PROBLEMS WERE IDENTIFIED TO:

1. OUTDATED OR MISSING REPAIR PROCEDURES.
2. MISSING NATIONAL STOCK NUMBERS

CORRECTIVE ACTIONS INCLUDE:

1. ADDITION OF NEW REPAIR PROCEDURES
2. ASSIGNMENT OF NEW NSN'S AND PART NUMBERS

CHART 18L OFF CHART 27R OFF
CHART 28R ON

THE TRAINING AFFORDED TO TROOPS BY ARMY AND CONTRACTOR SCHOOLS IS ADEQUATE. THE MAJOR PROBLEM LIES IN THE UNITS' ABILITY TO MAINTAIN THEIR AUTHORIZED STRENGTH OF TRAINED PERSONNEL.

CHART 28R OFF

CHART 19L ON

CHART 29R ON

THE FIELD SURVEY INDICATES THAT MANY MAINTENANCE PROBLEMS RESULT FROM A LACK OF QUALIFIED PERSONNEL. IN MANY CASES MEDICAL PERSONNEL ARE REQUIRED TO PERFORM MAINTENANCE FUNCTIONS ON NON-MEDICAL MUST COMPONENTS.

OBSOLETE TECHNIQUES FOR HONEYCOMB REPAIR AND ZIPPER REPLACEMENT, HAVE CAUSED SOME PROBLEMS. NEW TM'S IN PREPARATION WILL CONTAIN NEW STATE OF THE ART REPAIR TECHNIQUES.

SOME REPLACEMENT PARTS COULD NOT BE PROCURED BECAUSE MANUFACTURERS HAD DISCONTINUED PRODUCTION. ALTERNATE MANUFACTURERS HAVE BEEN FOUND FOR NEW PARTS. CURRENT NSN'S ARE BEING OBTAINED FOR THEM. THE UPDATED TM'S WILL INCLUDE THE NEW INFORMATION.

CHART 29R OFF

CHART 30R ON

THIS CHART SHOWS THE NUMBER OF REPAIR PARTS ON BACKORDER IN SUPPORT OF THE MUST SYSTEM. WE ARE UNABLE AT THIS TIME TO CONFIRM THAT THE AWARD FOR THE AIR PLENUM ASSEMBLY WAS MADE ON SCHEDULE. THERE ARE NO NORS REQUISITIONS ON BACKORDER FOR MUST SYSTEM REPAIR PARTS. ONE REQUISITION IS ON BACKORDER FOR THE ROTARY PUMP, THE BUTTERFLY VALVE AND THE ELECTRICAL PANEL PROTECTOR. THESE ITEMS ARE REQUIRED BY THE DEPOT FOR SCHEDULED OVERHAUL OF THE POWER PLANT. BALANCE OF BACKORDERS IS REQUIRED BY HOSPITAL DSU/GSU'S AS SPARES OR PLANNED REPLACEMENT OF ITEMS BECOMING UNSERVICEABLE. WE HAVE NO REPORT OF ANY MUST UNIT FAILING TO BE OPERATIONAL BECAUSE OF LACK OF THESE PARTS.

CHART 19L OFF

CHART 30R OFF

CHART 20L ON CHART 31R ON

SAFETY PROBLEMS CONCERNING THE POWER UNIT, AND INFLATABLE SHELTER HAVE BEEN IDENTIFIED. PROBLEMS AND THEIR CORRECTIVE ACTIONS ARE INDICATED ON THESE CHARTS.

SEVERAL ARE RELATED TO THE POWER UNIT:

FIRST, THE BLEED AIR HOSE ON BECOMING RIGID WITH AIR PRESSURE ROTATES RELEASING THE QUICK DISCONNECT COUPLING. THE ROTATION ALLOWS THE HOSE TO FLY LOOSE WITH CONSIDERABLE FORCE. FLARE FITTINGS ARE NOW REPLACING THE QUICK DISCONNECT COUPLINGS.

SECOND, DETERIORATING NOISE INSULATION IN THE INTAKE PLENUMS CREATES AN AIR BLOCKAGE RESULTING IN ENGINE OVERHEATING WITH A FIRE HAZARD. FIELD USERS HAVE BEEN INSTRUCTED TO REMOVE THE INSULATION.

THIRD, EXHAUST GASES DIRECTED UNDER THE POWER UNIT BY THE DRAIN TUBE CAN IGNITE COMBUSTIBLE MATERIAL UNDER IT. A REDESIGNED DRAIN TUBE BEING APPLIED BY RETROFIT, CORRECTS THIS PROBLEM.

FIRE HAZARDS ARE THE CHIEF SAFETY CONSIDERATIONS FOR THE INFLATABLE SHELTER. THE SPECIFICATIONS FOR THE SHELTER FLOORS, WALLS AND END PANELS HAVE BEEN REVISED TO INCLUDE ADDITIONAL FIRE RETARDANT TREATMENT. WE ARE AWARE OF NO PROCESS FOR COATING EXISTING SHELTERS WITH FIRE RETARDANT MATERIEL EITHER IN THE FIELD OR IN THE DEPOTS.

THE DIRECTION OF THE EXIT DOORS HAS BEEN CORRECTED TO OPEN OUTWARD. ANALYSIS OF FIRE EXTINGUISHER REQUIREMENTS HAS RESULTED IN AUTHORIZATION FOR INCREASED QUANTITY AND MORE VERSATILE TYPES.

THE NEW TECH DATA PACKAGE FOR ONGOING CONTRACTS INCORPORATES ALL THE INDICATED SAFETY CHANGES EXCEPT THOSE FOR FIRE EXTINGUISHERS.

CHART 20L OFF CHART 31R OFF

CHART 21L ON

TROSCOM TEAMS AND NARADCOM PERSONNEL PERIODICALLY VISIT POSTS, CAMPS AND STATIONS TO PROVIDE TECHNICAL ASSISTANCE TO MUST USERS. AN EVALUATION OF THE QUESTIONNAIRES INDICATES THAT TECHNICAL SUPPORT IS ADEQUATE.

CHART 21L OFF

CHART 22L ON CHART 32R ON

DEPOT STORAGE NEEDS IMPROVEMENT. THE DIRECTORATE FOR PRODUCT ASSURANCE HAS INITIATED CORRECTIVE ACTIONS FOR DEPOT STORAGE PROBLEMS. A QUANTITATIVE MEASUREMENT OF THE LEVEL OF RELIABILITY AND MAINTAINABILITY DEGRADATION WAS NOT MADE, BECAUSE OF LIMITED DATA AVAILABILITY.

THIS CHART PRESENTS A COLLECTIVE ACCUMULATION OF PROBLEMS REQUIRING CORRECTIVE ACTIONS AT DEPOT LEVEL. ITEMS A AND B HAVE RESULTED IN SHELTER DAMAGE, AND ITEM C HAS HAD A DETRIMENTAL EFFECT ON THE DEPOT'S ABILITY TO CHECK ITEMS BEFORE SHIPMENT. TROSCOM ELEMENTS ARE WORKING WITH THE DEPOTS TO RESOLVE THESE PROBLEMS.

CHART 22L OFF CHART 32R OFF

CHART 23L ON CHART 33R ON

CANADA IS THE ONLY FOREIGN NATION THAT HAS INDICATED A DESIRE FOR MUST EQUIPMENT. THIS CHART SHOWS THE QUANTITY OF EACH ITEM REQUISITIONED BY CANADA. THE CONFIGURATION OF CANADIAN HOSPITALS DIFFERS FROM THAT OF U. S. ARMY HOSPITALS.

BECAUSE MUST ITEMS HAVE A RELATIVELY LONG PROCUREMENT LEAD TIME, CANADA REQUESTED THE LOAN OF A POWER PLANT, AN EXPANDABLE SHELTER, MULTIPURPOSE SHELTERS, AND INFLATABLE SHELTERS. THESE ITEMS WERE NEEDED FOR TRAINING PURPOSES. THE POWER PLANTS WERE TRANSFERRED FROM ONGOING PRODUCTION. THE REMAINING ITEMS WERE LOANED, AS THE CHART INDICATES.

MUST EQUIPMENT IS SUITABLE FOR USE IN ANY DISASTER AREA, FOREIGN OR DOMESTIC.

CHART 23L OFF CHART 33R OFF

CHART 24L ON

TOBYHANNA AND TOOELE ARE THE PRIMARY DEPOTS SUPPORTING THE NON-MEDICAL MUST COMPONENTS. BOTH DEPOTS WERE QUERIED WITH RESPECT TO THE AREAS OF INTEREST INDICATED ON THE CHART. THEIR COMMENTS CAN BE SUMMARIZED AS FOLLOWS:

A. REBUILD INSTRUCTIONS ARE ADEQUATE. TROSCOM HAS PROVIDED SUPPLEMENTAL INSTRUCTIONS WHERE REVISIONS TO MANUALS ARE PENDING.

B. LACK OF SOME REPAIR PARTS HAS CAUSED MINOR PROBLEMS. WHERE NECESSARY, PARTS HAVE BEEN LOCALLY PURCHASED OR FABRICATED.

C. FACILITIES FOR REBUILD AT BOTH DEPOTS ARE ADEQUATE.

D. TRAINING FOR MUST REPAIR AND REBUILD IS SATISFACTORY AT BOTH DEPOTS. AT TOOELE MAINTENANCE PERSONNEL HAVE RECEIVED CONTRACTOR FACTORY TRAINING SINCE 1967. SINCE TOOELE IS THE PRIME DEPOT FOR OVERHAUL AND REPAIR OF THE POWER UNIT, MOST TRAINING HAS BEEN DIRECTED TOWARD THAT ITEM. AT TOBYHANNA MOST REPAIRS ARE ORIENTED TOWARD THE OTHER NON-MEDICAL COMPONENTS, AND TROSCOM HAS PROVIDED INFORMAL INSTRUCTIONS FOR THOSE ITEMS. TROSCOM WILL PROVIDE ADDITIONAL TRAINING ON REQUEST.

CHART 24L OFF

CHART 25L ON

THE ALTERNATIVES TO BE ADDRESSED ARE DISPLAYED ON THIS CHART.

CHART 25L OFF

CHART 26L ON CHART 34R ON

IN EVALUATING THE MUST NON-MEDICAL COMPONENTS, THE FACTORS LISTED ON THESE CHARTS WERE CONSIDERED. EXCEPT FOR THE FUNDING PROBLEM, CORRECTIVE ACTIONS ADDRESSING ALL OF THE NEGATIVE FACTORS HAVE BEEN INITIATED. DA IS AWARE OF THE FUNDING PROBLEM.

ON BALANCE, THE POSITIVE FACTORS ARE DOMINANT. THEREFORE, "FIX THE TOTAL PROBLEM" , IS THE SELECTED ALTERNATIVE.

THE OVERALL ASSESSMENT IS THAT THE NON-MEDICAL MUST COMPONENTS ARE CLEARLY PERFORMING THEIR INTENDED MISSIONS, AND SHOULD BE RETAINED IN THE ARMY INVENTORY.

ARE THERE ANY QUESTIONS?

CHART 26L OFF CHART 34R OFF

SYSTEM

ASSESSMENT

MUST

NON-MEDICAL COMPONENTS

PRINCIPAL COMPONENTS

1. POWER UNIT, UTILITY
2. SHELTER, EXPANDABLE
3. SHELTER, MULTIPURPOSE
4. SHELTER, INFLATABLE

COMPONENTS REQUIRED TO SUPPORT ONE HOSPITAL

TYPE HOSPITAL	POWER UNIT UTILITY	SHELTER EXPANDABLE	SHELTER MULTI PURPOSE	SHELTER INFLATABLE
COMBAT SUPPORT	9	10	20	16
EVACUATION	12	13	31	26

DATA SEARCH

QUESTIONNAIRES - TO MUST EQUIPPED HOSPITALS IN:

- CONUS (THRU HQ FORSCOM)
- EUROPE

FIELD VISITS - TO MUST EQUIPPED HOSPITALS AT:

- FT. BRAGG
- FT. RILEY
- FT. CAMPBELL
- FT. LEONARD WOOD

CONTACTS - WITH DEVELOPERS:

- MERADCOM
- NARADCOM

CONTACTS - WITH DEPOTS:

- TOOELE
- TOBYHANNA

OTHER CONTACTS: -

- DA-OFFICE OF THE SURGEON GENERAL
- FORSCOM
- DLSIE
- INTERNAL REV. & AUDIT DIV. (COMPTROLLER,TROSCOM)

SYSTEM ASSESSMENT GUIDELINES
MUST-NMC

GUIDELINE	PRIMARY RESPONSIBILITY
1. ORIGINAL DESIGN MISSION	DIR/PROD ASSUR
2. DEV. TEST & OPER. TEST RESULTS	DIR/PROD ASSUR
3. CORRECTIVE ACTIONS RESULTING FROM DEV. & OPER. TESTS	DIR/PROD ASSUR
4. INITIAL FIELD PERFORMANCE	DIR/MAINT
5. SYSTEM CHANGES SINCE ORIGINAL FIELDING	SPEC ITEMS MGT OFC
6. FIELD PERFORMANCE TODAY	DIR/MAINT
7. FIELD USER OPINION OF THE SYSTEM	DIR/MAINT

SYSTEM ASSESSMENT GUIDELINES
MUST-NMC

DEPOT EVALUATION:	PRIMARY RESPONSIBILITY
ADEQUACY OF MSC SUPPORT	
A. REBUILD INSTRUCTIONS	DIR/MAINT
B. COMPONENT PARTS	DIR/MAINT
C. FACILITIES	DIR/MAINT
D. TRAINING	DIR/MAINT

1. ORIGINAL DESIGN

2. DT-OT RESULTS (ET/ST)

UNRESOLVED DEFICIENCIES

ITEM	DEFICIENCY	SUGGESTED CORRECTIVE ACTION
UTILITY ELEMENT	AIR FILTER IS INADEQUATE FOR LOW TEMPERATURE OPERATIONS	REDESIGN AIR FILTER
INFLATABLE SHELTER	ZIPPERS BREAK AND WEAR OUT	NONE

3. IPT RESULTS AND CORRECTIVE ACTIONS RESULTING FROM DT/OT (ET/ST)

4. INITIAL FIELD PERFORMANCE

5. SYSTEM CHANGES SINCE ORIGINAL FIELDING

6. FIELD PERFORMANCE TODAY

7. FIELD USER OPINION OF SYSTEM

8A. PERFORMANCE (RAM)

8B. OPERATIONAL READINESS

8C. MANUALS AND TRAINING

MUST MANUALS

SHELTER EXPANDABLE	-	TM 10-5410-221-10 69, CHG 2 JUN 71, CHG 3 OCT 74, CHG 4 JUN 73
ZERO		TM 10-5410-221-24 68 CHG 2 JUN 71
		TM 10-5410-221-24P 69 CHG 2 JUN 71
SHELTER EXPANDABLE	-	TM 10-5410-221-14/1 NOT AVAILABLE UNTIL AUG 76
BRUNSWICK		TM 10-5410-221-20P/1 DEC 75
		TM 10-5410-221-34P/1 DEC 75
SHELTER INFLATABLE	-	TM 10-5410-222-10 69 CHG 1 DTD FEB 71, CHG 2 DTD APR 74
AIRESEARCH		TM 10-5410-222-23 68 CHG 2 DTD FEB 71, CHG 3 DTD MAR 75
		TM 10-5410-222-23P 69 CHG 1 DTD APR 69, CHG 2 DTD MAR 72
SHELTER INFLATABLE	-	TM 10-5410-222-13/1 NOT AVAILABLE UNTIL JUL 76
FIRESTONE COATED FABRICS CO.		TM 10-5410-222-23P/1 DTD JUL 75
SHELTER MULTI-PURPOSE	-	TM 10-5410-223-10 69 CHG 1 JUN 70, CHG 2 JUN 73, CHG 3 SEP 74
ZERO		TM 10-5410-223-24 69
		TM 10-5410-223-24P 70
SHELTER MULTI-PURPOSE	-	TM 10-5410-223-14/1 NOT AVAILABLE UNTIL JUL 76
BRUNSWICK		TM 10-5410-223-24P/1 DTD DEC 74

8D. CURRENT PROBLEMS

(1) MAINTENANCE

(2) SUPPLY

(3) SAFETY

MUST SAFETY PROBLEMS

POWER UNIT, UTILITY

PROBLEM	CORRECTIVE ACTION
BLEED AIR HOSE	LETTER OF INSTRUCTION SENT TO FIELD DIRECTING REPLACEMENT OF QUICK DISCONNECT COUPLINGS WITH FLARE FITTINGS. CHANGE TO TM IN PREPARATION.
INTAKE PLENUMS	MESSAGE SENT TO FIELD TO REMOVE ALL SOUND ATTENUATING MATERIAL FROM THE AIR INTAKE PLENUM. INSTRUCTION ALSO INCORPORATED INTO RETROFIT MANUAL.
DRAIN TUBE	FIELD ADVISED OF PROPER SET-UP PROCEDURE. REDESIGNED DRAIN TUBE INCORPORATED INTO RETROFIT MANUAL.

8E. TECHNICAL SUPPORT

8F. STOCKPILE RELIABILITY AND SPECIAL FACILITIES

8G. FOREIGN SALES AND MARKETABILITY

DEPOT EVALUATIONS OF MSC SUPPORT

A. REBUILD INSTRUCTIONS

B. COMPONENT PARTS

C. FACILITIES

D. TRAINING

9. ALTERNATIVES:

   A. FIX THE TOTAL PROBLEM

   B. DO WHAT WE CAN AND LIVE WITH THE PROBLEM

   C. GET RID OF THE SYSTEM

10. OVERALL ASSESSMENT

EVALUATION OF MUST-NMC

POSITIVE FACTORS

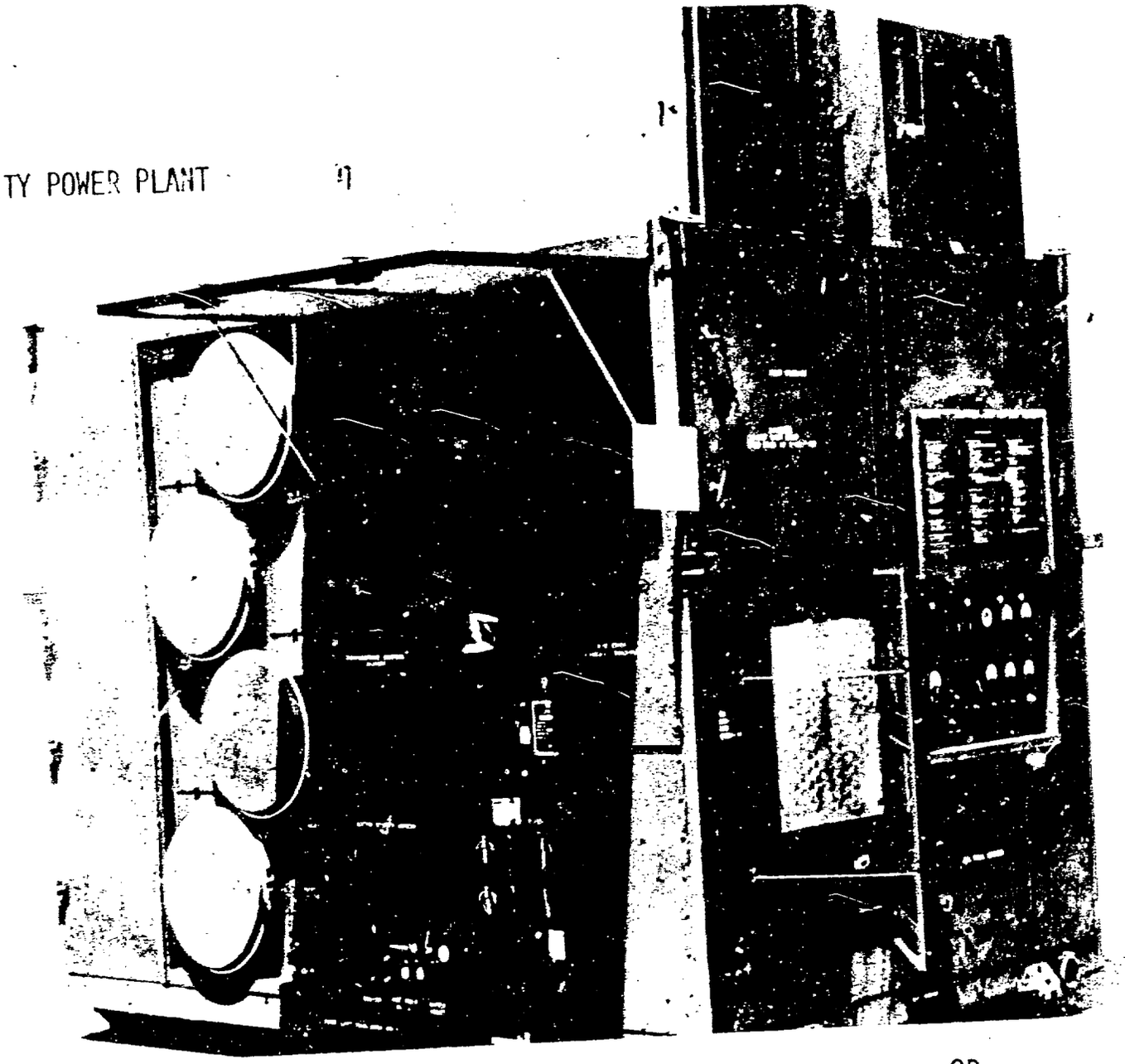
- HIGH MOBILITY
- HIGH RELIABILITY
- QUICK DEPLOYMENT
- CONTROLLED INTERNAL ENVIRONMENT
- ALL WEATHER OPERATIONAL CAPABILITY
- APPLICATION TO EITHER COMBAT CONDITIONS OR CIVILIAN EMERGENCIES
- FACILITIES ADEQUATE FOR QUALITY PATIENT CARE
- HARDWARE PROBLEMS RESOLVED/BEING RESOLVED BY RESPONSIBLE DEVELOPMENT COMMANDS

MEDICAL UNIT, SELF-CONTAINED, TRANSPORTABLE

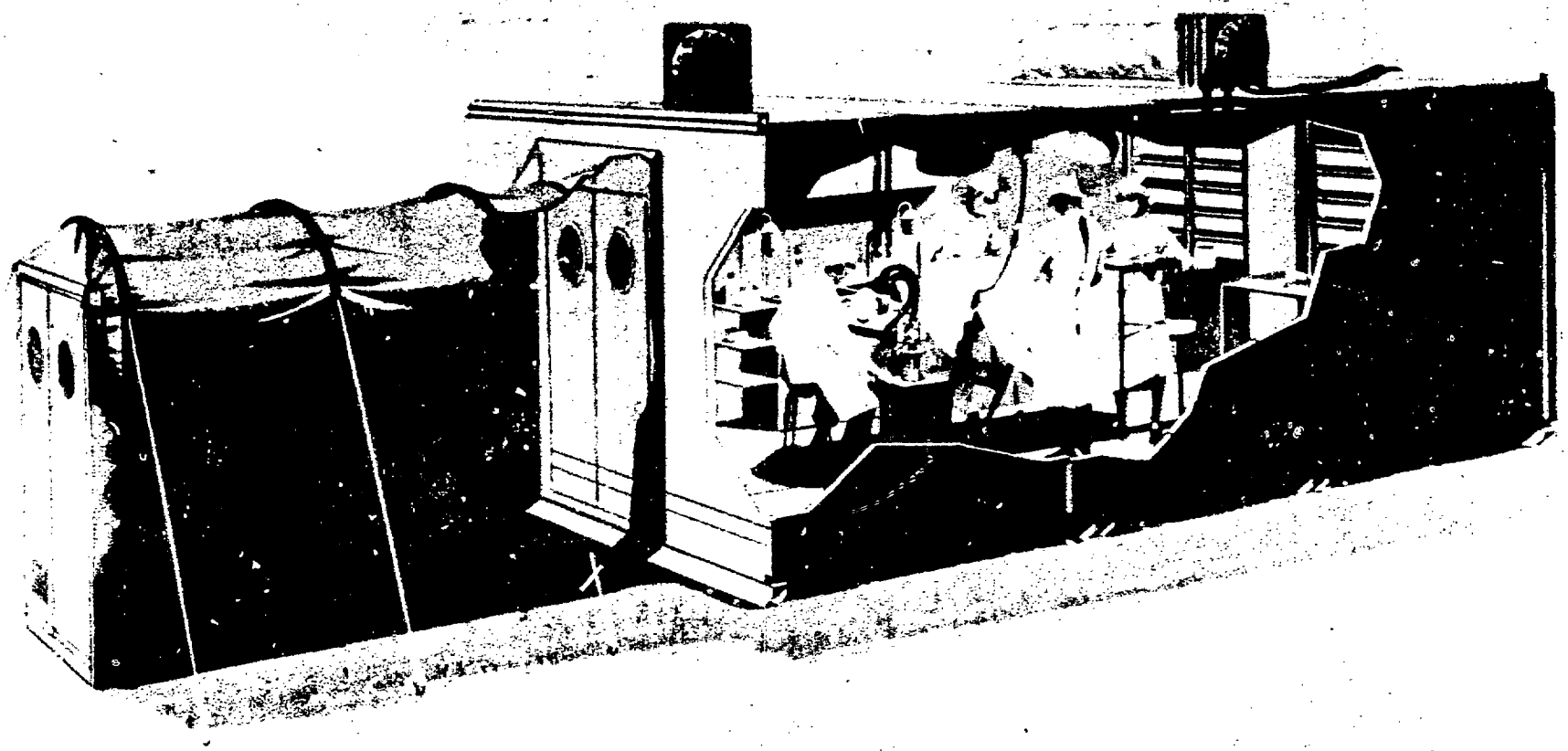
NON-MEDICAL COMPONENTS (MUST- NMC)

1R

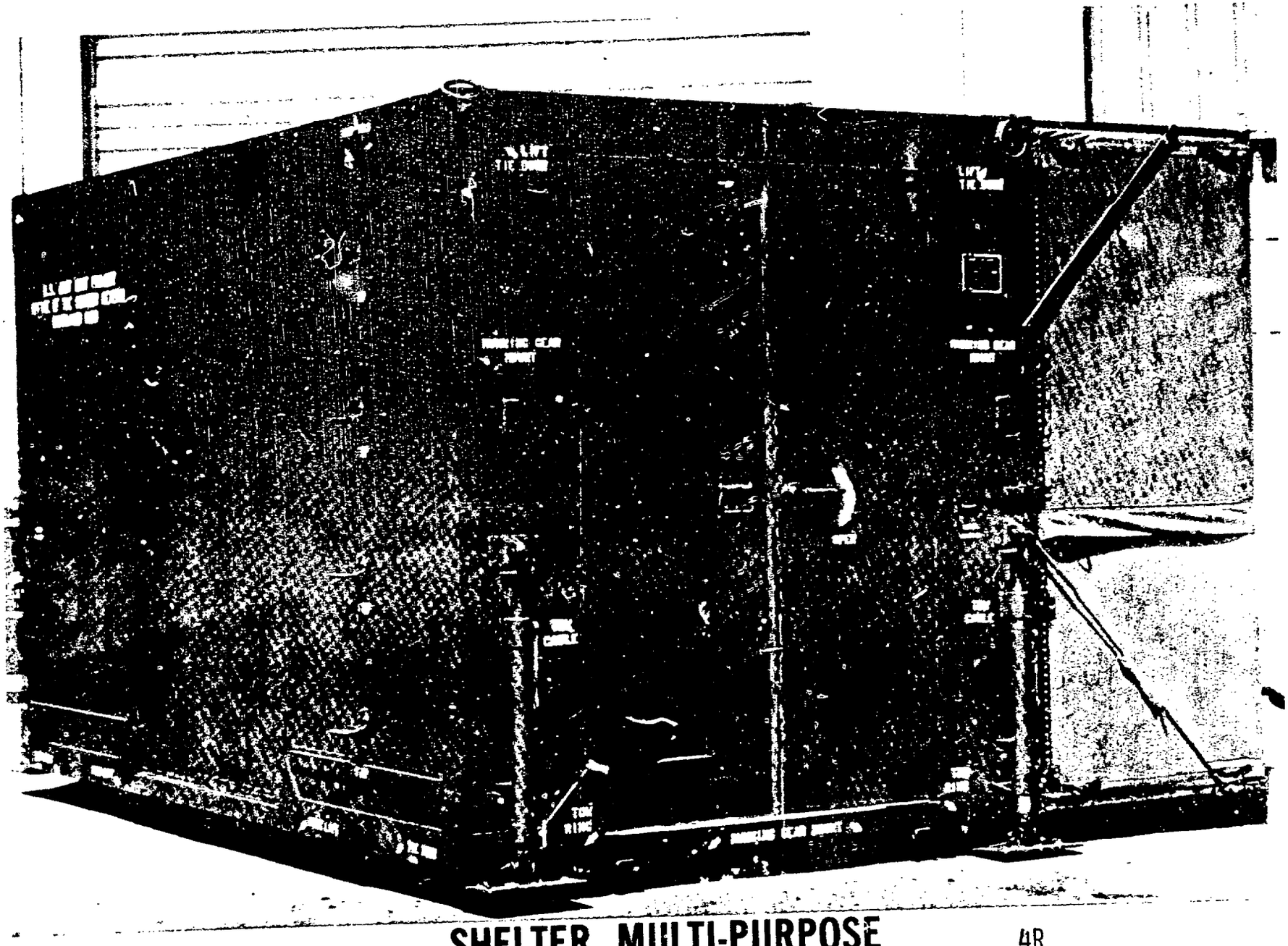
UTILITY POWER PLANT



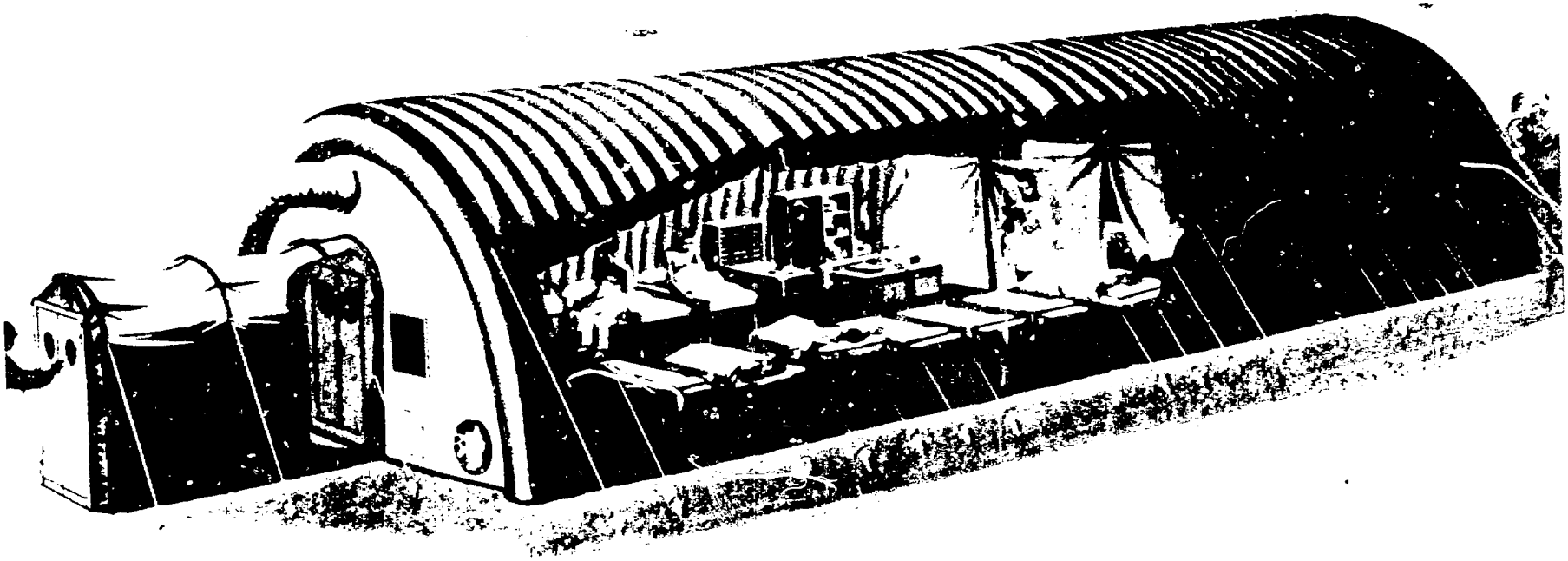
2R



MUST Field Hospital Expandable Element



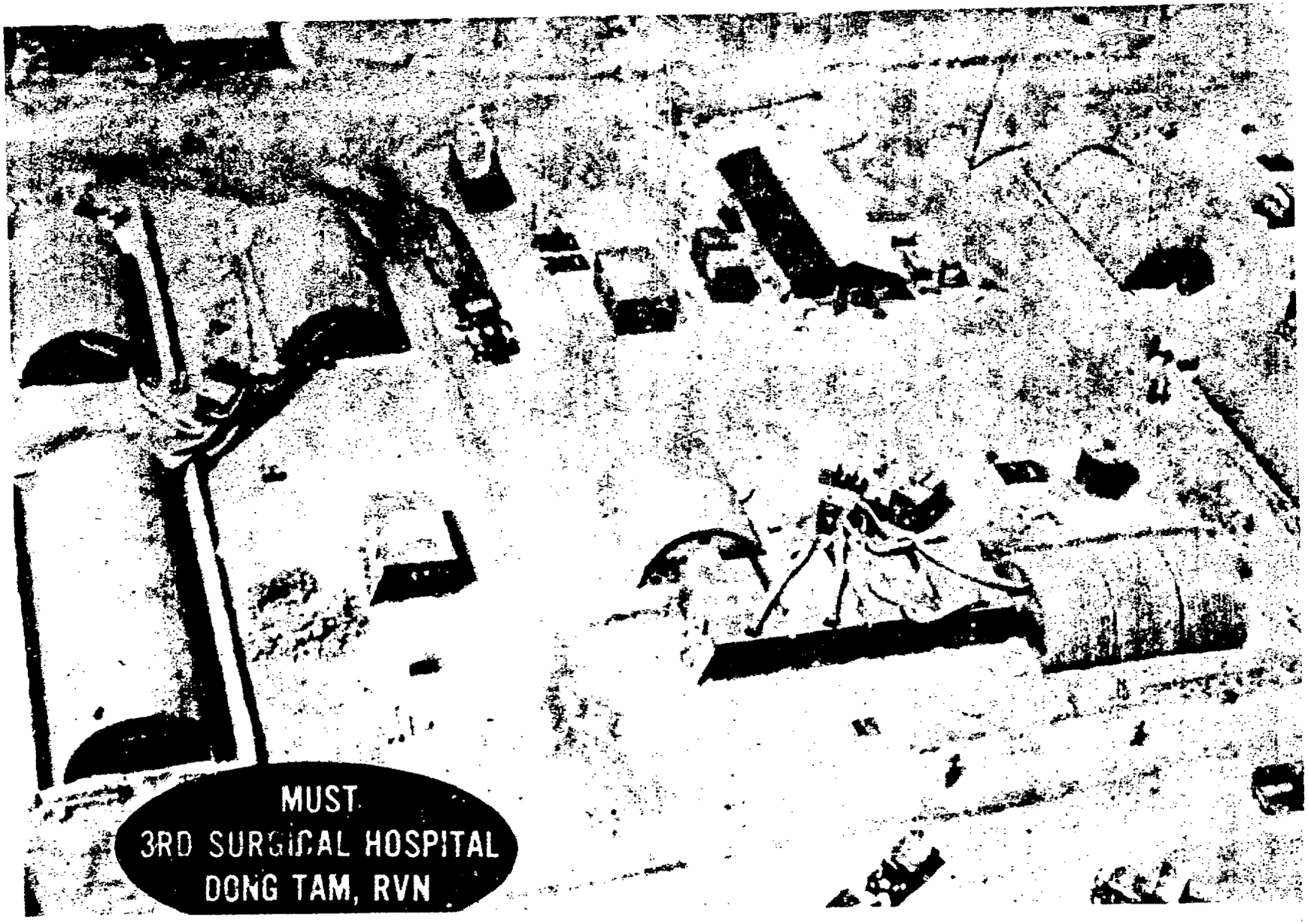
SHELTER, MULTI-PURPOSE 4R



MUST Field Hospital Inflatable Element

SYSTEM ASSESSMENT GUIDELINES
MUST-NMC

GUIDELINE	PRIMARY RESPONSIBILITY
8. CURRENT PROBLEMS	
A. PERFORMANCE (RAM)	DIR/PROD ASSUR
B. OPERATIONAL READINESS	DIR/MAT MGT
C. MANUALS & TRAINING	DIR/MAINT
D. PROBLEMS OF:	
(1) MAINTENANCE	DIR/MAINT
(2) SUPPLY	DIR/MAT MGT
(3) SAFETY	SAFETY OFFICE
E. TECHNICAL SUPPORT	DIR/MAINT
F. STOCKPILE RELIABILITY & SPECIAL FACILITIES	DIR/PROD ASSUR
G. FOREIGN SALES & MARKETABILITY	DIR/IL
9. ALTERNATE SOLUTIONS TO PROBLEM AREAS	SYS ANAL OFC
10. OVERALL ASSESSMENT	SYS ANAL OFC



7R

RESULTS: DT/OT II
(ENGINEERING AND SERVICE TESTS)

ITEM	MINIMUM USER REQUIREMENT	DT TEST RESULTS		OT (RVN) TEST RESULTS
UTILITY ELEMENT				
MTBF	560 HOURS	300 HOURS		244 HOURS
A. (A)	NONE	.9226	)	INSUFFICIENT
M.R.		.0839	)	DATA
EXPANDABLE SHELTER				
MTBF	560 HOURS	382 HOURS	)	INSUFFICIENT
A (A)	NONE	.950	)	DATA
M.R.		.05	)	
MULTI-PURPOSE SHELTER				
MTBF	560 HOURS	404 HOURS	)	INSUFFICIENT
A (A)	NONE	.9793	)	DATA
M.R.		.0178	)	
INFLATABLE SHELTER				
MTBF	560 HOURS	845 HOURS	)	INSUFFICIENT
A (A)	NONE	.9868	)	DATA
M.R.		.013	)	

ITEM	MINIMUM QMR REQUIREMENT	CURRENT SPECIFICATION REQUIREMENT	IPT RESULTS	FIELD RESULTS
A. UTILITY ELEMENT				
MTBF	560 HOURS	840 HOURS	272 HOURS	151 HOURS
A(a)		.95	.96	.9527
M.R.		.08	.038	.053
B. EXPANDABLE SHELTER				
MTBF	560 HOURS	NONE	IN PROCESS	1520 HOURS
A(a)				.963
M.R.		NONE		.039
C. MULTI-PURPOSE SHELTER				
MTBF	560 HOURS	NONE	912 HOURS	2156 HOURS
A(a)			.955	.9958
M.R.			.009	.0042
D. INFLATABLE SHELTER				
MTBF	560 HOURS	NONE	NOT ASSESSED	709 HOURS
A(a)		NONE		.9673
M.R.		NONE		.0334

INFLATABLE SHELTER
CORRECTIVE ACTIONS FOR FUTURE PROCUREMENTS
ACCOMPLISHED BY ECP

1. REINFORCED OPENINGS IN SOD CLOTH
2. TIE CORDS IN LONGER AND SMALLER LENGTHS
3. POSITIVE MEANS OF HOLDING WINDOW OPEN
4. LONGER WEB LOOPS ON ENTRYWAY
5. REPLACEMENT 20 AMP. CIRCUITBREAKER IN LIEU OF 15 AMP.
6. MODIFICATION OF LIGHT SUPPORT STRAPS
7. PROCEDURES AND ADHESIVE FOR DELAMINATION REPAIR
8. REPLACEMENT WARNING ON LIGHT FIXTURES
9. REVERSE DOORS TO OPEN OUTWARD

MUST EIR'S
POWER PLANT UTILITY

PROBLEM	SOURCE	CORRECTION
1. EXHAUST PLENUM DAMAGE.	(10) EIR'S - 1974-1975	EXHAUST PLENUM REDESIGNED.
2. INFLATION EJECTOR PICKING UP DEBRIS.	(1) EIR - 1975	REDESIGN OF EJECTOR.
3. JOURNAL BEARING FAILURE.	(1) EIR - 1974	REPLACED ORIGINAL BEARING WITH A NEW BRONZE BEARING.
4. DETERIORATING INSULATION.	(3) EIR'S - 1975	INSULATION REMOVED AND NEW RAIN COVER DEVELOPED
5. ICING OF AIR INLET FILTER.	(3) EIR'S - 1972-1975	NEW DEICING HOOD BEING EVALUATED.

MUST EIR'S

SHELTER EXPANDABLE

PROBLEM	SOURCE	CORRECTION
1. HONEYCOMB PANEL AND CORNER BRACE DAMAGE.	(3) EIR'S - 1974-1975	NEW REPAIR PROCEDURES AND PANEL AND BRACE CONSTRUCTION DESIGN CHANGED.
2. LEVELING JACK DAMAGE.	(3) EIR'S - 1974-1975	ACTION TAKEN TO ADVISE ALL USERS OF INSTALLATION OF GREASE FITTINGS. REDESIGN FOR NEW JACKS.
3. CONDUCTIVE FLOORING, GAPS BETWEEN STRIPS.	(1) EIR - 1972	UNIT ADVISED TO EXERCISE CAUTION WHEN SLIDING BULK OBJECTS SUCH AS CABINETS ACROSS SECTIONS OF FLOORING.
4. WEATHER STRIPPING (DOOR SEALS).	(1) EIR - 1972	INSTRUCTIONS FOR PROPER OPERATION OF DOORS BEING ADDED TO APPROPRIATE TM.

MUST EIR'S
SHELTER MULTI-PURPOSE

PROBLEM	SOURCE	CORRECTION
1. HONEYCOMB PANEL DAMAGE	(3) EIR'S - 1974-1975	NEW REPAIR PROCEDURES AND CHANGE OF PANEL DESIGN CONSTRUCTION.
2. LEVELING JACK DAMAGE	(3) EIR'S - 1974-1975	ACTION TAKEN TO ADVISE ALL USERS OF INSTALLATION OF GREASE FITTINGS. REDESIGN FOR NEW JACKS.
3. WEATHER STRIPPING (DOOR SEALS)	(1) EIR - 1972	INSTRUCTIONS FOR PROPER OPERATION OF DOORS BEING ADDED TO APPROPRIATE TM.
4. ADDITION OF SECURITY HASP FOR FOLDING FLOOR AND ROOF HATCH.	(1) EIR - 1976	EIR APPROVED BY OTSG, NARADCOM, AND TROSCOM. INSTRUCTIONS FOR INSTALLATION TO BE DISSEMINATED.

MUST EIR'S

SHELTER INFLATABLE

PROBLEM	SOURCE	CORRECTION
1. ZIPPERS - AIR LEAKAGE AND MALFUNCTION	(3) EIR'S - 72-75	NEW SUPPLIER OF IMPROVED ZIPPERS PROVIDED USERS WORLDWIDE. TROSCOM TEAM PROVIDED DIRECT ASSISTANCE TO USERS ON PROPER INSTALLATION PROCEDURES. TM'S CURRENTLY BEING REVISED TO INCLUDE PROPER INSTALLATION INSTRUCTIONS AND NSN'S FOR NEW ZIPPERS.
2. WEATHER SEAL ASSEMBLY	(2) EIR'S - 72-74	REDESIGN WEATHER SEAL.
3. ENTRANCE DOORS (OPENING DIRECTION)	(1) EIR - 74	NEW PROCUREMENT ACTION INCLUDES REVERSING DIRECTION OF DOOR OPENING. PROCEDURES FOR REVERSING DOOR OPENING DIRECTION ON FIELDED UNITS BEING FINALIZED.

SYSTEM CHANGES SINCE ORIGINAL FIELDING
UTILITY POWER PLANT

- NEW EXHAUST COMPARTMENT INSULATION
- NEW CONFIGURATION FOR HEAT CONTROL VALVE
- LOWER MOBILIZER BRACKET MODIFICATION
- AIR DUCT STORAGE RETENTION INSTALLATION
- TOP PROTECTIVE COVER AND TIE DOWN INSTALLATION
- CONDENSER COMPARTMENT WATER DRAINAGE MODIFICATION
- TOP COVER GRATING INSTALLATION
- EXHAUST DISCHARGE BOX MODIFICATION
- AIR DUCT SEAL MODIFICATION
- ENGINE AIR INTAKE DUCT INSULATION
- NEW IMPROVED FUEL CONTROL UNIT INSTALLED
- NEW IMPROVED BRONZE JOURNAL BEARING IN TURBINE ENGINE
- TECHNICAL MANUALS ARE BEING REWRITTEN TO INCORPORATE ALL CHANGES
- SPECIFICATION HAS BEEN REWRITTEN AND STAFFED FOR COORDINATION
- NEW IMPROVED FUEL FILTER SEPARATOR
- NEW MULTI-SPEED SWITCH

SYSTEM CHANGES SINCE ORIGINAL DESIGN
EXPANDABLE SHELTER

- NEW IMPROVED SEALS ON FOLDING ROOF HINGELINES, DOORS, SIDE PANELS
- NEW IMPROVED CONDUCTIVE FLOORING AND METHOD OF INSTALLATION
- NEW IMPROVED LEVELING JACKS INSTALLED
- NEW "HOT BOND" PROCESS SPECIFICATION FOR MANUFACTURE OF ALUMINUM FACED HONEYCOMB SIDE WALLS AND ROOF PANELS
- NEW REPAIR PROCEDURES HAVE BEEN ESTABLISHED FOR FIELD AND DEPOT

SYSTEM CHANGES SINCE ORIGINAL FIELDING
MULTI-PURPOSE SHELTER

- NEW IMPROVED VINYL COATED FLOORING.
- NEW IMPROVED FABRIC ENCLOSURE.
- NEW "HOT BOND" PROCESS SPECIFICATION FOR MANUFACTURE OF THE ALUMINUM-FACED HONEYCOMB SIDE WALLS AND ROOF PANELS.
- NEW IMPROVED METHOD FOR INSTALLATION OF LIFTING RING BRACKETS, BOLT INSERTS AND EPOXY FOR BRACKETS.
- NEW IMPROVED LOCK PINS TO HOLD LEVELING JACKS IN UP POSITION DURING TRANSPORT.
- NEW DESIGN FOR ANTI-BACK DRAFT VALVE COVER PLATE.
- NEW REPAIR PROCEDURES HAVE BEEN ESTABLISHED FOR FIELD AND DEPOT.
- DELETION OF THE SHELTER LOADING KIT FOR LOADING ONTO 2½ TON TRUCKS. SHELTERS NOW TO BE TRANSPORTED BY TACOM DOLLYS.

SYSTEM CHANGES SINCE ORIGINAL DESIGN
INFLATABLE SHELTER

- NEW IMPROVED WEB SEAM CONSTRUCTION IN EACH BLADDER COMPARTMENT
- NEW IMPROVED ADHESIVE USED IN MANUFACTURE OF SHELTER
- LOWER PRESSURE RELIEF VALVE SETTING FOR BLADDERS
- ADDITIONAL 1 OZ PER SQ.YD. OF NEOPRENE COATING AUTHORIZED ON BLADDER MATERIAL TO DECREASE THE POROSITY AND INCREASE AIR RETENTION
- NEW IMPROVED HEAVY DUTY DESIGN OF THE INFLATION VALVE AREA
- NEW TUBULAR FLUORESCENT LIGHTS RUNNING FULL LENGTH OF SHELTER BOTH SIDES IN LIEU OF SQUARE LIGHTS RUNNING DOWN MIDDLE OF SHELTER
- MATERIAL USED THROUGHOUT THE SHELTER IS MORE FIRE RETARDANT THAN SHELTERS ORIGINALLY BUILT
- DIFFERENT MANUFACTURE FOR SLIDE FASTENERS (SCOVILL IN LIEU OF COATS & CLARK)

FIELD PERFORMANCE TODAY

	QUANTITY	LAST 12 MO. PERIOD HOURS OF OPERATION	TIMES SET UP
POWER PLANT UTILITY	66	43,078	---
SHELTER EXPANDABLE	58	------	79
SHELTER MULTI-PURPOSE	86	------	101
SHELTER INFLATABLE	120	------	56

MUST RAM

SYSTEM REQUIREMENTS

	MINIMUM USER REQUIREMENT	DEMONSTRATED DURING DEVELOPMENT TESTS	ESTIMATED AS A RESULT OF FIELD DATA
MEAN TIME BETWEEN FAILURE (MTBF)	140 HRS	104 HRS	109 HRS
ACHIEVED AVAILABILITY $A_{(A)}$ (UTILITIES)	.99	.96	.9527
MAINTENANCE RATIO (M.R.)	.0529	.165	.1296

MUST-NON-MEDICAL COMPONENTS
RECOMMENDATIONS TO IMPROVE RAM

1. ESTABLISHMENT OF A USER'S MAINTENANCE TEAM.
2. ESTABLISHMENT OF A SPECIFIC MUST MAINTENANCE MILITARY OCCUPATIONAL SPECIALTY (MOS).
3. APPLICATION OF LIFE CYCLE COST MODEL TECHNIQUE TO POWER UNIT.
4. STANDARDIZATION OF ZIPPERS USED ON THE INFLATABLE SHELTER TO INSURE COMPATIBILITY.

REQUIREMENTS VS ASSETS
HOSPITALS

COMBAT SUPPORT HOSPTIAL (CSH) - 200 BEDS
EVACUATION HOSPITAL (EVAC) - 400 BEDS

	ACTIVE ARMY CSH/EVAC	NG CSH/EVAC	RESERVES CSH/EVAC	TOTAL CSH/EVAC
REQUIREMENTS	18/3	8/5	19/13	45/21
ASSETS (THRU FY 77 FDP)	18/3	8/5	4/4	30/12
SHORTAGES	0/0	0/0	15/9	15/9

FY 76 DOLLARS (IN MILLIONS)*

REQUIREMENTS	38.6/9.2	17.1/15.4	40.7/40.0	96.4/64.6
ASSETS (THRU FY 77 FDP)	38.6/9.2	17.1/15.4	8.6/12.3	64.3/36.9
SHORTAGES	0/0	0/0	32.1/27.7	32.1/27.7

* NON-MEDICAL COMPONENTS

REQUIREMENTS vs ASSETS
MAJOR COMPONENTS

	AAO	W/W ASSETS 3QFY76	DUE IN THRU FY77 FDP	LOSSES THRU FY77 FDP	TOTAL ASSETS	SHORTAGES
POWER PLANT	702	269	223	10	482	220
SHELTER, EXPANDABLE	733	348	125	12	461	272
SHELTER, MULTI PURPOSE	1617	780	208	17	971	646
SHELTER, INFLATABLE, 5 SEC	1325	558	366	26	898	427

23R

OTSG PROCUREMENT SCHEDULE

TYPE HOSPITAL	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9	80	TOTAL
COMBAT SUPPORT	5	2	5	5	4	4	5	4	5	6	45
EVACUATION	2	0	2	1	4	2	1	4	3	2	21
FUNDED	7	2	7	6	8	6	6	0	0	0	42

← ACTUAL → ← PLANNED →

MUST HOSPITAL SYSTEM
AGE OF INVENTORY

	POWER UNIT	SHELTER EXPANDABLE	SHELTER, MULTI PURPOSE	SHELTER, INFL, 5 SEC
FY66	20			26 - OVER AGE
FY67				
FY68	97	17		
FY69		165		
FY70				
FY71			43	355
FY72			133	
FY73	60			
FY74	92			12
FY75		3	516	60
FY76		152	88	96
				25R

MUST MANUALS - POWER PLANT

POWER PLANT UTILITY, MOD. PPU-85-4 -	TM 5-6115-434-12	DEC 68 CH1 MAY 69, CH2 MAY TO CH3 JUN 71, CH4 AUG 73, CH 5 JAN 75
MOD. PPU-85-5 -	TM 5-6115-434-20P	APR 69, CH3 DEC 70, CH5 FEB 72, CH6 SEP 73
	TM 5-6115-434-35	NOV 69, CH1 MAY 70, CH2 JAN 71, CH4 DEC 72, CH5 SEP 73
	TM 5-6115-434-35P	MAY 70, CH1 DEC 70, CH3 FEB 72, CH4 SEP 73
POWER PLANT UTILITY, MOD. APP1 AMERTECH -	TM 5-6115-590-12	NOT AVAILABLE UNTIL MAY 77
	TM 5-6115-590-20P	NOT AVAILABLE UNTIL MAY 77
	TM 5-6115-590-34	NOT AVAILABLE UNTIL MAY 77
	TM 5-6115-590-34P	NOT AVAILABLE UNTIL MAY 77

MUST MANUALS - POWER PLANT (CONTINUED)

POWER PLANT UTILITY, MOD. LPU 71 LIBBY	- TM 5-6115-586-12	JUN 72, CH1 AUG 74
	TM 5-6115-586-20P	SEP 72, CH1 AUG 74
	TM 5-6115-586-34	JUN 72, CH1 AUG 74
	TM 5-6115-586-34P	AUG 72, CH1 AUG 74
GAS TURBINE ANALYZER	- TM 5-4920-200-15	SEP 63
	TM 5-4920-200-25P	FEB 70
SERVICE UNIT REFRIGERATION	- TM 5-4130-234-13 AND P DTD DEC 74	
POWER PLANT UTILITY	- DMWR 5-6115-434 DTD AUG 74	

MUST TRAINING

1. FIELD TRAINING PROVIDED BY TROSCOM ON AN AS REQUIRED BASIS FOR POWER PLANT UTILITY.

2. 424 HOURS OF TRAINING PROVIDED TO 96 STUDENTS BY TROSCOM, 1974-1975.

3. 1750 HOURS OF TECHNICAL ASSISTANCE HAVE BEEN PROVIDED BY TROSCOM, 1974-1975.

4. TRAINING CONTINUING BY TRAINING SCHOOL, FT. SAM HOUSTON.

5. POWER PLANT TRAINING CONTINUING BY ENGINEER SCHOOL, FT. BELVOIR, VA.

CURRENT PROBLEMS

MAINTENANCE

1. LACK OF QUALIFIED MAINTENANCE PERSONNEL.
2. OBSOLETE REPAIR PROCEDURES IN TM'S.
3. DISCONTINUED PRODUCTION OF REPLACEMENT PARTS.

MUST REPAIR PARTS STATUS

END ITEM	REPAIR PARTS	B/O QTY	GET WELL	REMARKS
POWER PLANT, UTILITY				
	PUMP, ROTARY	1	MAR 77	ON CONTR
	VALVE, BUTTERFLY	8	MAY 77	ON CONTR
	PANEL PROTECT, ELEC	4	OCT 76	ON CONTR
SHELTER, INFLATABLE				
	FLOOR ASSY, SEC	1	NOV 76	ON CONTR
	PLENUM ASSY, AIR	1	AUG 76	CONTR AWD 30 APR 76
	PANEL ASSY, END	7	JUN 76	UNDER OVERHAUL
	PLENUM ASSY, AIR	15	JUL 76	ON CONTR
	DISTR BOX	2	SEP 76	ON CONTR

MUST SAFETY PROBLEMS
SHELTER, INFLATABLE

PROBLEM	CORRECTIVE ACTION
FIRE RESISTANCE	SPECIFICATION REVISED TO IMPROVE FIRE RESISTANCE MATERIALS INCLUDING A FIRE RETARDANT COATING ON THE BASIC FABRIC MATERIAL AND FIRE RETARDANT TREATMENT OF THE POLYURETHANE FOAM.
EXIT DOORS	ECP APPROVED REVERSING THE DIRECTION DOORS OPEN.
FIRE EXTINGUISHERS	ADDITIONAL QUANTITIES AND TYPES OF FIRE EXTINGUISHERS AUTHORIZED.

STORAGE PROBLEMS

A. IMPROPER FORK LIFTING

B. IMPROPER STORAGE

C. LIMITED TEST FACILITIES

MUST HOSPITAL SYSTEM

INTERNATIONAL MARKETABILITY

REQUIREMENTS

ITEM	QTY	COUNTRY	CASE NO.	DELIVERY DATE	ON LOAN
POWER PLANT	6	CANADA	MIB	DELIVERED	0
SHELTER, EXPANDABLE	8	CANADA	MIB	4QFY76	1
SHELTER, MULTI-PURPOSE	13	CANADA	MIB	DELIVERED	2
SHELTER, INFLATABLE, 5 SECTION	11	CANADA	MIB	4QFY76	2

EVALUATION OF MUST-NMC

NEGATIVE FACTORS

- HIGH FUEL CONSUMPTION BY POWER UNIT
- FREEZING OF POWER UNIT AIR FILTER AT LOW TEMPERATURE
- EASILY DAMAGED FLOOR IN EXPANDABLE SHELTER
- INCOMPATIBILITY OF REPLACEMENT WITH ORIGINAL ZIPPERS FOR INFLATABLE SHELTER
- INFLUENCE OF LOW USAGE ON RAM SYSTEM PERFORMANCE
- HIGH PROCUREMENT COSTS, MAKING SYSTEM VULNERABLE TO FUNDING CUTBACKS

APPENDIX B

4 DEC 1975

AMSTS-KH

SUBJECT: System Assessment for the Medical Unit, Self-Contained, Transportable (MUST) Non-Medical Components

Commander
US Army Tank-Automotive Command
ATTN: AMSTS-W
Warren, MI 48090

1. Subject assessment addresses field performance, problems, and corrective actions regarding the non-medical components utilized in the MUST Hospital System.

2. This Command contacted The Office of The Surgeon General (OTSG) using units by having each unit complete a questionnaire (Incl 1). With regard to TACOM components, the units commented on the Dolly Sets. Inclosed is a copy of the questionnaires and indicated below are specifics:

a. Dolly Sets are unsafe for transportation in the empty configuration. Bolts which hold the two assemblies together come loose.

b. Dolly Sets cannot safely be transported at a spped of more than 15 MPH in the empty configuration or 25 MPH when the dolly is carrying a load.

c. Hydraulic rams fail excessively (seem to be too small).

3. In view of the foregoing, request an evaluation of the inclosed questionnaires and the specifics indicated in paragraph 2 above. Your input will be used in an assessment briefing to be presented to the TROSCOM Commander, tentatively scheduled for end of January 1976 and in turn forwarded to AMC for final review and assessment; therefore, an early

AMSTS-KH 4 DEC 1975

SUBJECT: System Assessment for the Medical Unit, Self-Contained, Transportable (MUST) Non-Medical Components

reply would be appreciated.

FOR THE COMMANDER:

1 Incl
as

M. L. GARDNER
Colonel, GS
Chief, Special Items Mgt Ofc

AMSTA-MVA (4 Dec 75) 1st Ind Mr. Murphy/dv/369-2485
SUBJECT: System Assessment for the Medical Unit, Self-Contained, Transportable (MUST) Non-Medical Components

Headquarters, US Army Tank Automotive Command, Warren, Michigan 48090 21 JAN 1976

TO: Commander, U.S. Army Troop Support Command, 4300 Goodfellow Blvd, St. Louis, Missouri 63120, ATTN: AMSTS-KII

1. It is agreed that the dolly sets are unsafe to operate at any speed with the coupling bolts loose. We recommend periodic checks of these bolts to insure tightness, presence of lock washers, etc.

2. When these dolly sets are properly maintained, the maximum safe towing speeds are:

50 MPH Highway

25 MPH Cross Country

The above speeds should be reduced as conditions may dictate.

3. Engineering efforts are in progress to improve the hydraulic lift system.

4. Review of the attached questionnaires reveals 2 basic problems:

a. Parts not properly identified in the parts manual.

b. Lack of experienced repair personnel in the organizational and DS shops.

5. Continuing provisioning efforts and a manual revision program are being pursued to solve problem 4 a. above.

6. There is nothing about these dolly sets beyond the abilities of automotive repairmen. We feel local Command action to obtain properly trained personnel is the best approach to problem 4 b. above.

FOR THE COMMANDER:

M. J. GALLI
C, Spec Purp Veh Div

1 Incl
nc

APPENDIX C

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
AMSTS-QR	Identification of Potential RISE Candidates for the MUST Utility Element

TO: SEE DISTRIBUTION

FROM: Director for Product Assurance

DATE: 2 JAN 76

CMT 1

LT Colson/sg/2870

1. References:

a. AMCR 702-15, dated 13 Apr 72, subject: Reliability, Availability and Maintainability Improvement of Selected Equipment (RISE).

b. TROSCOM Supplement 1 to AMCR 702-15, dated 8 Nov 73.

2. In accordance with the procedures described in paragraph 7c Phase 1 Identification of reference 1a and within the responsibilities assigned by reference 1b, this Directorate has completed a life cycle cost analysis of the MUST Utility Element, Incl 1. The purpose of the analysis was to identify areas for possible improvement which have a high potential for payoff in terms of reduced logistics and/or operating costs.

3. This analysis resulted in a listing of components in relative order of their impact on life cycle maintenance support cost. This list suggests that there are potential payoffs to be realized through improvements in the reliability and maintainability characteristics of the components.

4. All addressees are requested to review the analysis and provide substantive comments and recommendations concerning the means by which improvement in the reliability/maintainability of the MUST Utility Element can be realized. Data and related analyses supporting the recommendations should also be provided. Replies are requested NLT 15 Jan 76.

5. Chief, SIMO, in addition to paragraph 4, should initiate requisite actions to perform Phase 2 - Engineering Analysis pursuant to reference 1b.

6. Action officer in this Directorate for the MUST RISE Program is Mr. A. Christensen, Ext 2878.

ROBERT C. COOK
Director for Product Assurance

1 Incl
as

DISTRIBUTION:
AMSTS-K
AMSTS-M
AMSTS-S
AMSTS-P
AMSTS-G

DA FORM 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE.

☆GPO-1975-605 422/1063

RISE PROGRAM

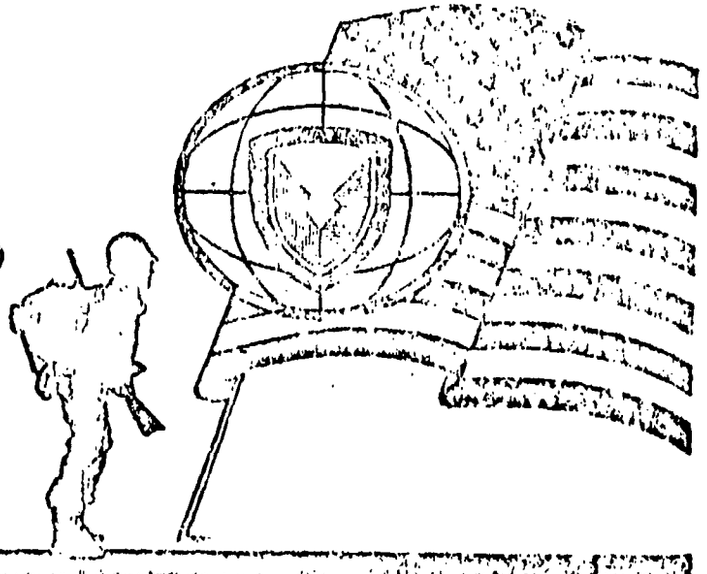
PHASE I - IDENTIFICATION

MUST UTILITY ELEMENT

31 DEC 75

Prepared by _____
LT COLSON
R&M Division
Product Assurance

Approved by _____
WILLIAM STACK
Acting Chief
R&M Division
Product Assurance



U. S. ARMY
TROOP SUPPORT COMMAND

4300 GOODFELLOW BLVD.
ST. LOUIS, MISSOURI 63120

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1 Jan 74

RISE PROGRAM - PHASE I

Identification of Areas of Potential Improvement MUST Utility Element

PURPOSE: To provide information that can be used to develop product improvement proposals that will result in an increase in the reliability and maintainability of the MUST Utility Element and, subsequently, a decrease in the overall logistics support costs.

OBJECTIVE: To perform a life cycle cost analysis of the MUST Utility Element in order to systematically identify, in relative order, those areas contributing to the overall logistics support costs.

APPROACH: The Life Cycle Cost Model was used to calculate the life cost of the current configuration of the utility element. This included cost of repair parts, maintenance, training, manuals, storage, procurement, field use, overhaul, disposal and associated shipments. Components of the MUST Utility Element that contribute most to the logistics support cost were identified by comparison of mean-time-between-failure (MTBF) and cost of failure. The model was then used to calculate the life cycle cost of the utility element using estimated, improved reliability values. These calculations were performed twice for each major cost driver; thus, twenty-eight independent estimates were made. Only elements of the life cycle cost effected by the improved reliability parameters were changed in each calculation. All other costs remained constant. Components were ranked by comparing differences in current and predicted life cycle costs associated with each cost driver.

CONCLUSIONS:

1. The components of the MUST Utility Element listed in Table 1 are the major cost contributors of the system. The ranking in Table 1 does not include an evaluation of the susceptibility of these components to engineering changes. The following symbols are used in Table 1:

   a. θ_1 - present MTBF in hours
   b. θ_e - expected MTBF in hours
   c. θ_d - desired MTBF in hours
   d. S_e - anticipated savings at θ_e
   e. S_d - anticipated savings at θ_d

2. The total anticipated savings available based on an inventory of 492 items is shown in Table 2.

TABLE 1

ITEM	θ_1	θ_e	θ_d	S_e	S_d
Condenser Fan	2458	5412	7000	16	11
Compressor, Refr	5408	10000	15600	7.8	10
Fuel Control	3605	9900	10800	7.0	7.2
Heat Load Control	5645	8250	16000	3.0	6.2
*400 Hz Generator	4000	7500	22000	4.2	1.2
Hot Water Pump	10816	16400	22000	1.3	-1.3
Heat Exchanger	4159	6000	8300	.93	-1.2
400 Hz Panel	6008	7500	10000	.59	-.89
Ignition	9013	16000	22000	.35	-.74
Cold Water Pump	7725	10816	22000	-.97	.54
Battery Charger	18026	22000	54000	-.42	.25
Multispeed Switch	18000	22000	54000	-.65	.21
**Check Valve, Refr	5408	7500	18000	-.25	-.15
**Selenoid Valve, Refr	18026	22000	54000	-2.5	-1.9

Savings are expressed in thousands of dollars per item. Minus figures indicate anticipated loss.

*θ1, θe and θd represent mean-times-between-overhaul rather than mean-times-between-failure for the generator.

**These items are unlikely candidates for improvement as their evaluation indicated no savings; therefore, they have been omitted from TABLE 2.

TABLE 2

ITEM	BEST CASE	MOST LIKELY	WORST CASE
Condenser Fan	7.7	5.3	4.8
Compressor, Refr	4.9	4.9	3.8
*Fuel Control	3.6	3.5	2.0
Heat Load Control	3.1	1.5	.66
400 Hz Generator	2.1	.55	-.31
Hot Water Pump	.63	.30	-.65
Heat Exchanger	.46	.46	-.61
400 Hz Panel	.29	.12	-.44
Cold Water Pump	.26	.14	-.23
Ignition	.16	.076	-.24
Battery Charger	.12	.057	-.21
*Multispeed Switch	.10	.041	-.20

Savings are expressed in millions of dollars. Minus figures indicate anticipated loss.

*Both of these items have been changed by recent ECP's; therefore, they do not represent favorable candidates for further product improvement at this time. They are included primarily for an estimate of the expected savings from the changes and because they fell within the criteria of major cost drivers.

RECOMMENDATIONS:

1. Recommend feasibility studies be conducted on the items listed below to determine what actions can be taken to improve their reliability. This listing includes an estimate of the susceptibility of these items to engineering changes. Components are listed in recommended order of priority.

   a. Refrigerant Compressor

   b. Condenser Fan

   c. Heat Load Control Valve

   d. 400 Hz Generator

   e. Heat Exchanger

   f. Hot Water Pump

   g. Cold Water Pump

   h. 400 Hz Protective Panel

   i. Ignition Unit

   j. Battery Charger

2. Achieving savings through improvement of cost drivers can be realized primarily by keeping improved component cost as low as possible while increasing reliability.

3. Recommend no effort be expended in attempting to improve or identify ways to improve the refrigerant check valve or selenoid valve as analyses of these items resulted in anticipated losses.

DETAILS OF ANALYSIS:

1. The MUST Utility Element was studied in depth through the use of technical manuals, contractor reports, test reports and field data. The purpose of the familiarization was to provide a background sufficient to analyze the system and organize it into functional groups. These functional groups or subsystems were further subdivided down to the component level.

2. In order to allocate reliability to the components, it was necessary to obtain as much factual use data as possible. Most of the required data was available from the Trial Application

of the Life Cycle Cost Model and MUST 1 and 2 user operation tests RVN. It was not possible to establish reliability values from factual data for all components at the level of assembly under evaluation. When necessary, values were assumed or estimated from data on like items and by conferring with engineers familiar with the utility element. After reliability had been allocated, component values were reconciled with demonstrated system reliability and maintenance ratio.

3. The life cycle cost of the current configuration was then calculated by application of the TROSCOM Life Cycle Cost Model. Estimates made included cost of improved items, development, publications and overhaul. Every available resource was used whenever possible to enhance the accuracy of these estimates.

4. Twenty items were identified as having low reliability and relatively high cost to replace. The fourteen major cost drivers were chosen as those items which represented a cost of one-half million dollars or more over the life of the MUST Utility Elements.

5. In order to obtain the development cost, improved item cost and the improved MTBF, research was carried out on like items associated with the components in question. Estimates of the state-of-the-art were necessary to project realistic expected and desired mean-times-between-failure. Engineering change proposals submitted by Airesearch and MERDC were of great assistance in this phase of the analysis. The principle of diminishing returns was used as the relationship between reliability (product) and development money (resource). This exponential dependence is also used in The Use of Lagrangian Multipliers for Optimum Reliability Allocation by Robert Davison, February 1972.

6. Having estimated the desired and expected MTBF from the demonstrated MTBF, the associated costs were used to calculate the life cycle costs at the expected and desired reliabilities. The differences between these costs and the life cycle cost of the current configuration represented the anticipated savings or loss. The components were then ranked in order of expected savings. The total savings expected from the improvement of each component was calculated based on an inventory of 492 utility elements. Engineering judgement and estimated susceptability of components to changes were used to differentiate between the most likely, worst and best cases. From these rankings and comments of engineering associates, recommendations were proposed.

REFERENCES:

1. TROSCOM letter to U. S. Army Materiel Command, dated 11 Jul 75, subject: Progress Report on TROSCOM's Life Cycle Cost Model.

2. TM-5-6115-434-12, Dec 68.

3. TM-5-6115-434-20P, Apr 69

4. Engineering Change Proposal 74CE0845, Centrifugal Multispeed Switch, dated 17 May 74.

5. Engineering Change Proposal 74CE0844, Fuel Control Valve, dated 17 May 74.

6. Airesearch Corporation Report #73-310328-1, undated.

7. Airesearch Corporation Report #74-310703, undated.

8. Planning Research Corporation Preliminary Flat Rate Table, 11 Mar 74.

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